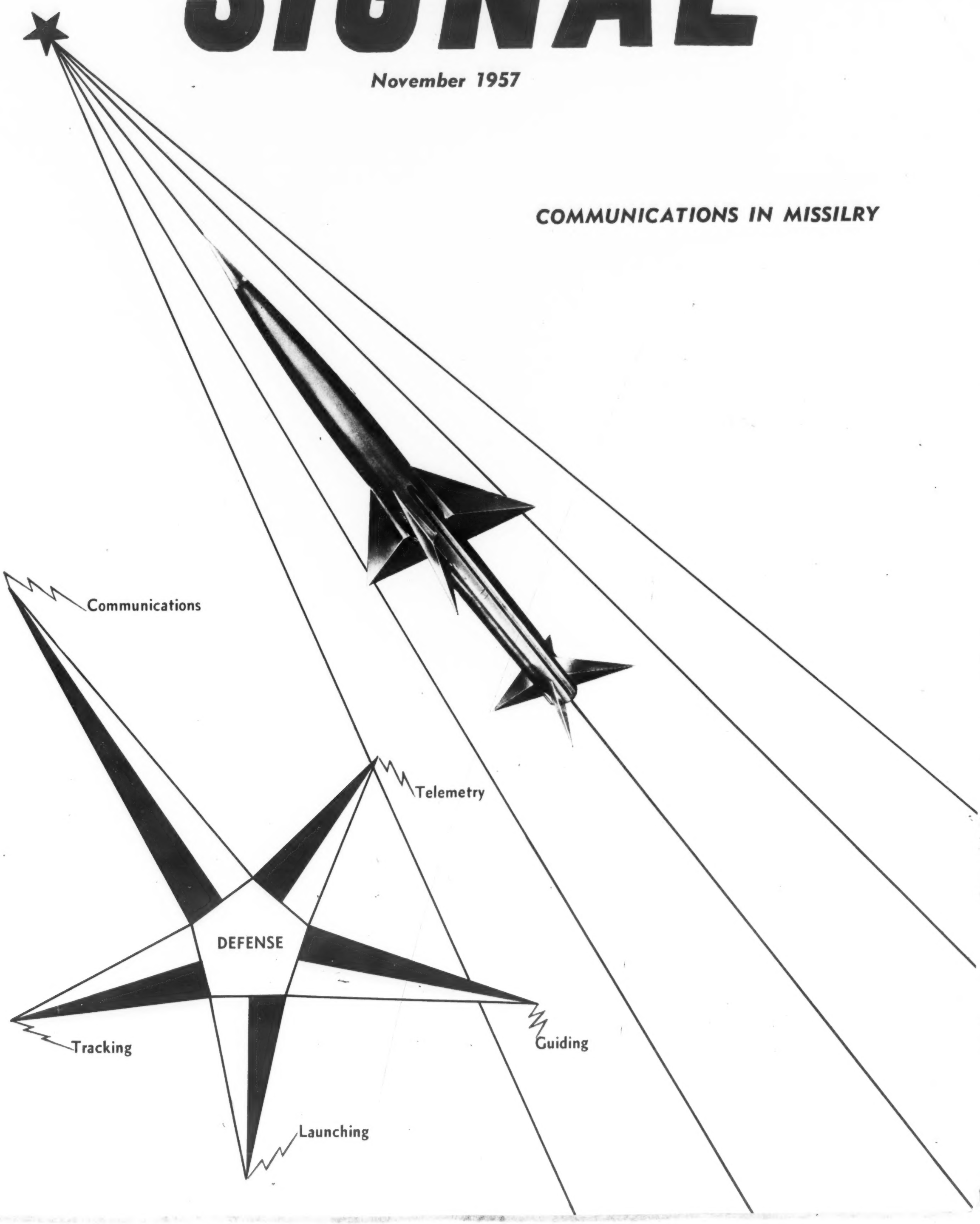
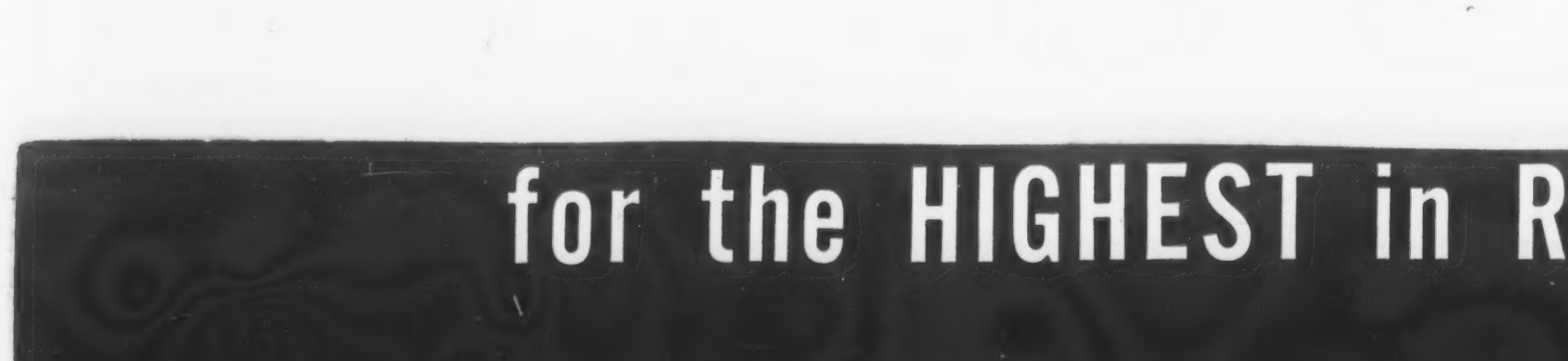
SIGNAL

November 1957

COMMUNICATIONS IN MISSILRY



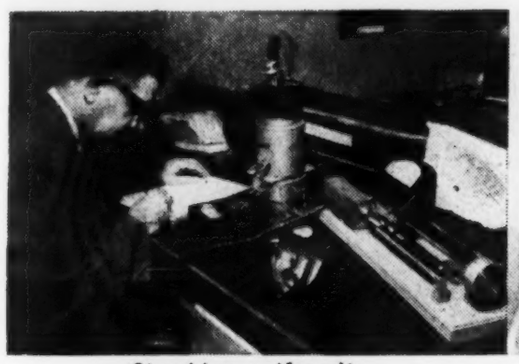
for the HIGHEST in RELIABILITY



Qualitative micro analysis.

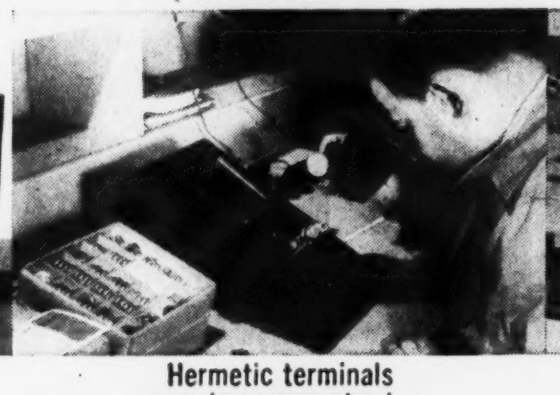
Vibration stress analysis.

Torque testing of standard assemblies.

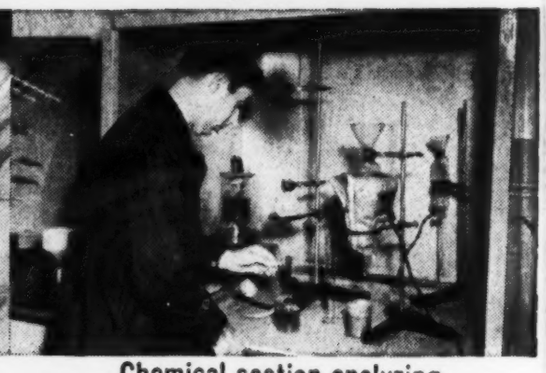


Checking uniformity of thermoplastic compounds.

Quantitative checking of weld strength.

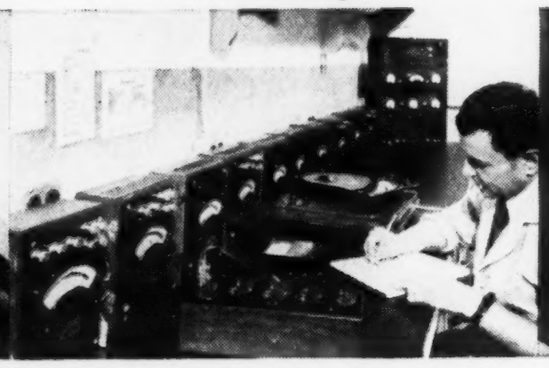


Hermetic terminals on microscope check.

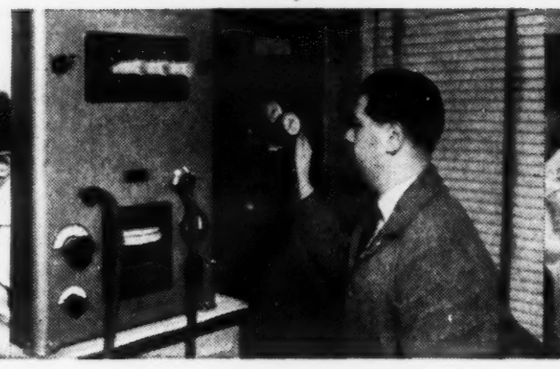


Chemical section analyzing new materials.

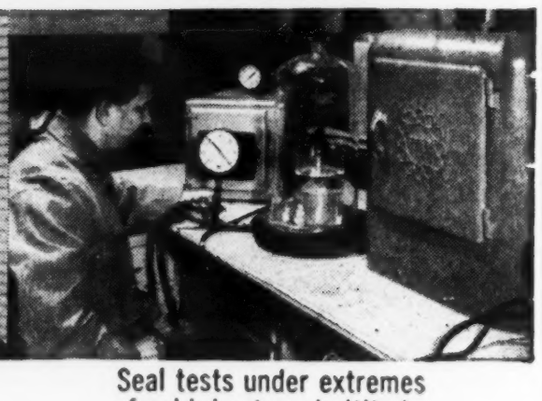
Microscope analysis of dissected units.



Calibration to primary standards.



Pilot plant hydrogen annealing.

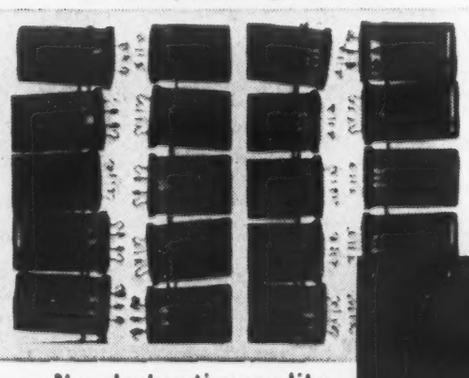


Seal tests under extremes of cold, heat, and altitude.

Abrasion and mercury tests on magnet wire.

Pilot plant run on encapsulating material.

Corrosion testing on insulating materials.



Non-destructive quality control by x-ray.

IS THIS PROVEN RELIABILITY AND UNIFORMITY IN THE COMPONENTS OF YOUR EQUIPMENT?

A large aircraft company..."Our vendor analysis for past year (thousands of tests) shows zero rejects."

A large electric company..."Consistent quality has placed you as our #1 source...are grateful for the aid you have given our own quality control staff."

A large military electronics company..."Switching from former vendor to UTC has saved us 18% of transformer and filter cost by reducing manufacturing costs."

A large instrumentation company..."We haven't had one field failure in fifteen years' use of UTC parts*."

*Over 100,000 units.

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SEVEN AGES OF THE TELEPHONE

ALL THE WORLD'S A STAGE, *and all the men and women merely players. . . . And one man in his time plays many parts, his acts being seven ages. At first the infant . . .* SHAKESPEARE

All through the years, from babyhood on, the telephone is an important, indispensable part of almost everything we do. And as the hands that grasp the telephone grow in size and usefulness, so grows also the usefulness of the telephone.

BABY DAYS At first the telephone is just something that rings. But soon the lusty newcomer is saying "hello, Daddy" all by himself and listening in wide-eyed wonder to the magic of Daddy's voice.

GROWING UP It isn't long before the telephone becomes more than a magical fascination. It begins to be something for doing things. A particular pal to call. And a very necessary part of growing up.

DYNAMIC TEENS Life is now a whirl of activity. So many things to do. Girl talks to girl. And boy talks to girl. And there are two happy hearts when she says, "I'd love to go."

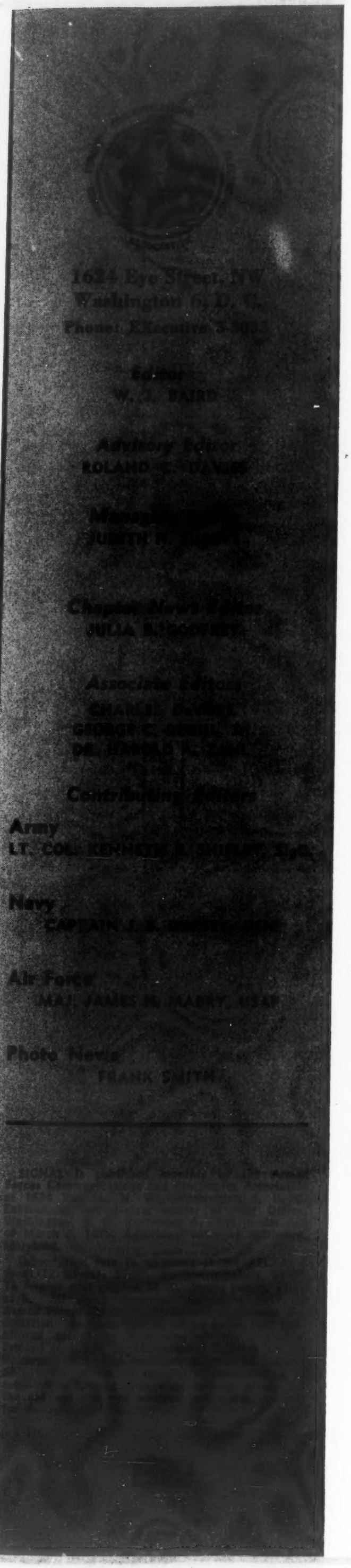
JUST MARRIED Two starry-eyed young people starting a new life together. The telephone, which is so much a part of courtship, is also a big help in all the marriage plans and in getting settled.

EARNING A LIVING The years go by and always there is the responsibility of earning a living. Here again the telephone is a speedy, willing, ever-present helper. It is a part of the daily work and the progress of almost everyone.

RAISING A FAMILY Now the telephone becomes more useful than ever. For how could Mother ever run her household and raise a family without it! Friends, relatives, stores, doctors, conveniences —all are so easy to reach by telephone.

IT'S GRANDMA NOW And now she's holding a grandchild on her lap. The telephone that has served her so faithfully now starts a new era of service. The cycle of life and the seven ages of the telephone begin all over again.

Working together to bring people together . . . **BELL TELEPHONE SYSTEM**



SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XII **NOVEMBER 1957** **NUMBER 3**

CONTENTS

Features

DEPARTMENTS

COVER

The missile on the cover is the Sperry Sparrow I. Admiral Arleigh Burke, Chief of Naval Operations, credited "years of intensive development by the Bureau of Aeronautics and Naval Air Missile Test Center and Sperry for the readiness of the Fleet with this air-to-air missile system." See page 13 for a first release story on the design, development and production of a complete missile system. The cover illustration by the Editor portrays the importance of electronics to defense in this epoch of missilry.

A FRESH APPROACH TO CLOSE TOLERANCE NEEDS

FEATURES

• Now available in 5 wattage ratings • Metallic resistive film accurately controlled and applied to special high quality ceramic cores • Designed to surpass characteristic A of specification MIL-R-10509B • Low noise level independent of range • Voltage coefficient can be disregarded

Here are molded metal film resistors that set new standards of performance—units that will withstand full load at 125° C. ambient to zero at 175° C. In addition to high initial accuracy, these new MIL type units combine a stability on load and a low, controlled temperature coefficient never before available in film resistors. They also provide low inductance and shunt capacitance plus excellent high frequency characteristics.

Small in size and weight, IRC precision metal film resistors can replace precision wire wound resistors in many applications. They are available in five temperature coefficient spans for maintaining or controlling resistance over wide temperature ranges. They can be used where high stability must be obtained under difficult load and humidity conditions. You'll also want to investigate them for high frequency applications. Send for complete details.

Insulated Composition Resistors • Deposited and Boron Carbon Precistors • Power Resistors • Voltmeter Multipliers • Ultra HF and Hi-Voltage Resistors

Wherever the Circuit Says

Low Wattage Wire Wounds • Resistance Strips and Discs • Selenium Rectifiers and Diodes • Hermetic Sealing Terminals • Insulated Chokes • Precision Wire Wounds • Potentiometers

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From the President

In my last message, I spoke of the possibilities of creating a greater interest at our chapter meetings by discussing timely subjects and events relating to our national welfare. I also hinted at the importance of being alert to the problems of balancing heavy industrial requirements against the needs of an expanding economy. In short, I was saying that the future of America depends upon how well we as a Nation utilize our economic resources in advancing our national objectives.

This is a process known as economic mobilization. Its phraseology is meaningful and carries a dynamic connotation which is profoundly important to all of us in the communications and electronics field. It is the responsibility of our citizens and our industrial organizations to plan, cooperate, control and coordinate the transformation of the Nation's productivity from a peace time economy to an emergency status. In this age when time has been reduced from days to minutes, it is necessary to prepare the blue prints for tomorrow's eventualities now if we are to support our defense requirements at home and abroad and, at the same time, maintain a progressive day-to-day civilian economic balance. This must be done in concert with our peace time responsibilities to assist our allies and to help them in developing a stable economic posture. This transformation does not fall upon industrial management alone, and neither is it a spontaneous evolution. It must be sparked and directed by the Federal Government, for this is the law of the land. The point to remember is that we should see to it that action is taken now to prepare against the day of reckoning, so that our organizations for national security have the means to provide for the defense of our Nation, and to win quickly and as economically as possible should a war be thrust upon us. This is our challenge, since ultimate success or failure of national mobilization, and the operation of the economy before and after mobilization, depends to a maximum degree upon the people.

Perhaps President Eisenhower, in his State of the Union message on February 2nd, 1953, has provided us with the foundation on which to build for our future security when he said, "Our problem is to achieve adequate military strength within the limits of endurable strain upon our economy." . . . "To amass military power without regard to our economic capacity would be to defend ourselves against one kind of disaster by inviting another." . . . "We must effectively integrate our armament programs and place them in such careful relation to our industrial facilities that we assure the best use of our manpower and our materials. To have peace and security, we need above all to be strong and alert; we need unified effort."

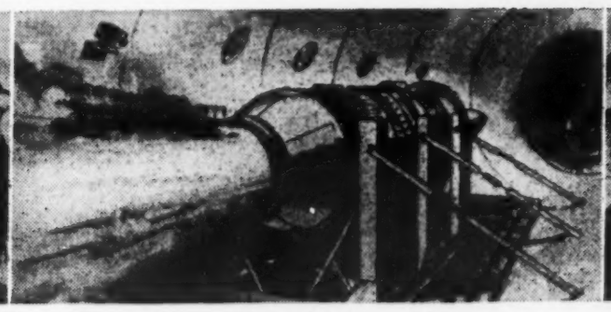
The next point I would like to make relates to the importance of bringing new blood into the chapter organizations. It is my unshakable conviction that each chapter can benefit materially by electing to chapter offices each year young executives representing the various industries in the communications, electronics and photographic fields, together with engineers, educators and scientists working on research and development, and other dynamic leaders within the community. A constant change within the chapter organization assures new ideas, but even more, provides a means for making the Armed Forces Communications and Electronics Association and its official publication, SIGNAL, known to a greater number of people.

With the appointment of a new Executive Vice President at national headquarters, who will devote much of his time to the furtherance of closer association with the chapters and the expansion of our association, and with the publication of a top-flight monthly magazine, SIGNAL, we have every reason to believe there will be a steady and progressive growth in the months ahead. This growth can be stimulated by bringing new men into the chapter organization and by a little effort on the part of our present members in encouraging new membership among their friends.

Frederick R. Furth

MIRACLE IN MINIATURE

Observation and control of amphibious and airborne landings.



Close observation of jet or piston engine test performance.

Surveillance of assembly areas and movements of forces.

Observation of danger areas, where exposure would involve danger to personnel.

Brand new! RCA "Telemite" (model JTV-1) a 1-pound ultra-miniature television camera, makes possible direct observation of sites and events never before accessible by TV

It fits lightly into the hand; it can be carried in a pocket; it weighs about a pound; it will go places too small for ordinary cameras, too dangerous for man; it will observe without being conspicuous; it may be mounted on a tripod, fastened to wall or bulkhead, hand-held by a pistol grip. Size: 1⅞" x 2⅜" x 4¾".

By means of a transistorized circuit and the new RCA half-inch Vidicon, the "Telemite" actually surpasses standard Vidicon-type industrial TV cameras in sensitivity. It produces clear, contrasty pictures with a scene illumination of 10-foot candles or less.

The "Telemite" operates with up to 200 feet of cable between it and the control monitor, and this distance can be further extended by using a repeater amplifier. This is the first TV camera to employ photoelectric sensitivity control, which provides automatic adaptation to widely varying scene illumination.

DEFENSE ELECTRONIC PRODUCTS

RADIO CORPORATION of AMERICA

CAMDEN, N.J.

Tmk(s) ®

electronics in NEW WEAPON SYSTEMS

WIDESPREAD ANXIETY APPEARS TO exist in the electronics industry. Aircraft manufacturers gradually are encroaching on the electronics and communications field.

The general scramble throughout industry for trained engineers and skilled technicians, especially those with backgrounds and schooling in the relatively new field of electronics, is popularly taken for unmistakable evidence of this trend.

Thus needless but quite natural rivalries and resentments between the electronics and aviation industries are springing up as the aircraft and missile designers have come to rely increasingly upon electronic components to make possible the performance demanded of modern day weapon systems.

eas,
olve

Yet many of these same rivalries and resentments are rooted in the misunderstanding of why the aircraft and missile makers are so concerned with developing their electronic capability. This capability must be developed if we are to take necessary cognizance of the ever-growing role electronics can play in our offensive and defensive military planning.

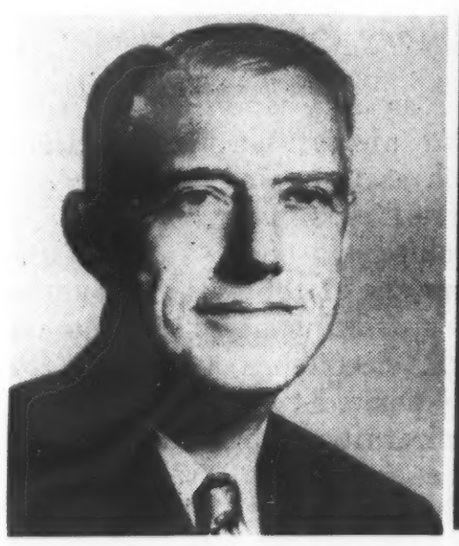
The building of a capable electronics engineering staff by an aircraft or missile manufacturer is just as legitimate and necessary as the development of a staff of competent propulsion engineers. In order to design advanced manned and unmanned aerial weapons, we have to have maximum competence in propulsion engineering. But this does not mean we manufacture engines or that we intend to in the future.

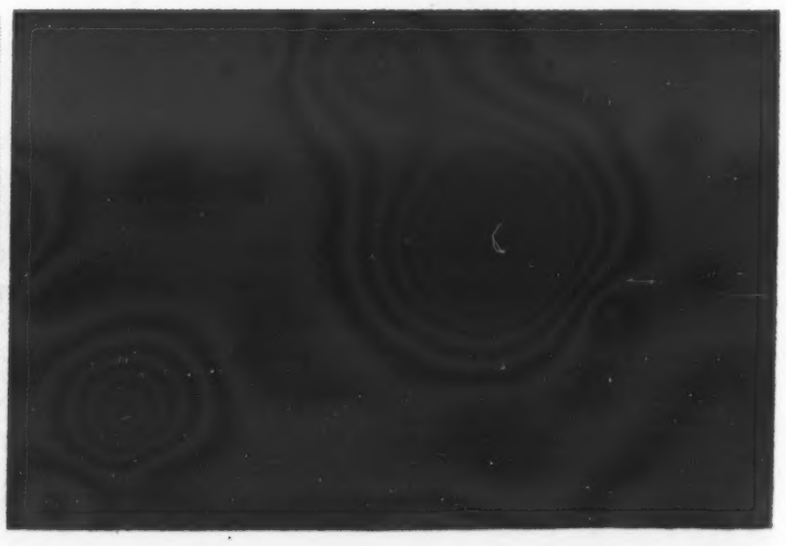
By now, everyone must be familiar with the truly formidable technical production problems created by the swift advent of supersonic and hypersonic aerial vehicles, both manned and unmanned. We are indeed straining at the leashes of scientific knowledge in many areas—in metallurgy, in high-altitude physics, in the behavior of materials and electrical components at elevated temperatures, in the so-called exotic fuels and their related propulsion problems—to name just a few of our trouble spots.

We cannot afford to minimize the difficulty of any of these problems. However, in the development of present day weapons to meet present day threats, and in the planning and designing of tomorrow's weapons to counter tomorrow's threats, we have one dominant responsibility. This responsibility underlies everything we produce or plan to produce for the military services, and for the civilian market as well. It is summed up in the word "reliability."

Not too many years ago, in aerial weapons, for example, reliability centered on three factors: a relatively slow airplane, the courageous man who flew it, and the guns he was given to aim and shoot with his own hands and eyes, or the bombs his aircraft was equipped to drop on military targets. Reliability was only as good as the human in the cockpit was skillful in manipulating the equipment he was given—only as good as the judgment he was capable of applying to each combat situation.

Today, this is no longer quite true and with the passing of each year, the reliability task is becoming less and less simple. Today, we are flying interceptor aircraft that can travel faster than sound and automatically can fire their rocket and guided missile armament at enemy targets our pilots may not actually have seen.





Bombardiers, too, could destroy or extensively damage targets obscured by weather or darkness. Supersonic guided missiles, equipped with electronic devices that help the weapon seek, find and knock down a fast-moving target regardless of visibility, can be launched from land, sea and air.

All of these sophisticated and complex weapons are useful militarily only to the degree that they—and the even more complex launching and directing systems of which they are just a part—can be relied upon to stop or impair the effectiveness of an enemy attack or accomplish the military objectives of our own retaliatory forces.

Seldom is there a weapon in today's military arsenal that is not a part of a larger and even more complicated system—an equipment complex created to detect, track and counter any enemy threat from the air or to cope with a surface attack launched from ground or ocean.

At many points in these complex systems, the human is still the vital decision-making, judgment-exercising element, but in a far different way than in the old dog-fighting aerial combat sense of World Wars I and II. Whenever an "either or" decision must be made, whenever a "now or later" judgment becomes necessary, we as yet have devised no substitute for the human brain.

Nevertheless, the employment of that human judgment is reduced almost to futility if any of the critical components of a complex weapon system fails to function properly. And in truth, there are today many combat situations in which human judgment alone no longer can be relied upon for the rapid calculations and motions made necessary by the very high speeds at which our modern aerial weapons are traveling. Increasingly, we find ourselves relying more and more upon the tools that electronics have given us—high-speed but compact computers, radar and other circuits that can sense the presence of a target not visible to human eyes, devices that move control surfaces far faster and with infinitely greater sensitivity than human hands or feet, gyros that are not subject to vertigo or the disorienting pressures of high G forces induced by acute maneuvers at high speeds.

Thus, not only are our individual weapons themselves more complex today than they were a decade ago, but they also perform effectively only in relation to the other segments of the weapon system of which they are the punch-delivering part.

To an aircraft or missile manufacturer such as Convair Division of General Dynamics Corporation, this means three primary things. . . .

1. He must design components in terms of the whole weapon system. Each must be intimately related to the limitations of the others in the system, trailing neither too far behind the technological levels of the other elements nor leading too far ahead.

2. If the weapon system is to function effectively throughout, the designer must make it relatively simple to maintain, and the training and skill levels demanded of the men responsible for maintenance of all its individual elements in operational use obviously must fall far below those of the men who designed and developed those elements for production.

3. He must so design and develop the system that it is producible by present-day shop standards. True, in many areas of the aircraft and missile industry, shop technology is far advanced over that of other less exacting industries. The aircraft-missile industry works to far closer tolerances and the components it creates and purchases from other suppliers must be not only much more precise in performance but also much more rugged than are the products with which all of us are familiar in our daily lives —our automobiles, TV sets, radios, automatic appliances and the like.

Granting the validity of these basic industrial principles, it can be seen that to remain competitive with other manufacturers and to continue to provide the kind of advance product planning that is dictated by modern military technology, we as an aircraft and missile manufacturer have had to develop our weapon system design and management capability. Going hand-in-hand with this is the increasing necessity to design for maintainability, and to keep fabricating techniques and the employment of revolutionary new materials and processes consonant with the design sophistication of all the weapon system elements.

Military Procurements

Today, as a weapon system designer, an aircraft-missile manufacturer such as Convair must devote a large part of its engineering, research and development effort to the electronic aspects of the systems on the company's drawing boards. Only six years ago, electronics accounted for only 6.1 per cent of the U.S. Air Force's aircraft and related procurement. Yet in fiscal 1957, this percentage had climbed to 17.3 per cent, or 1.4 billion dollars of the 8.4 billions spent for aircraft and related products. And in the procurement of other than aircraft and similar equipment, electronic and communication devices accounted for more than 70 per cent of USAF purchasing in fiscal 1956-57. In the first half of fiscal 1957, approximately 367 million dollars were spent by the Department of Defense for procurement of electronics and communications, and 368 million during the corresponding period of fiscal 1956. These figures exclude electronic and communication equipment installed as integral components of aircraft, ships, vehicles, artillery, missiles, weapons and other equipment.

The three Services spent almost 3.7 billions for aircraft procurement in the first half of fiscal 1957, almost 300 millions more than in the same period a year ago. For missiles the three Services spent slightly more than 850 millions, compared with about 445 millions in the first half of fiscal 1956.

While there are strong indications that future military procurement will be pared down, it would be foolhardy to predict any decline in the proportion of outlay that will be devoted to electronics and related electrical equipment in our future aircraft and missile procurement.

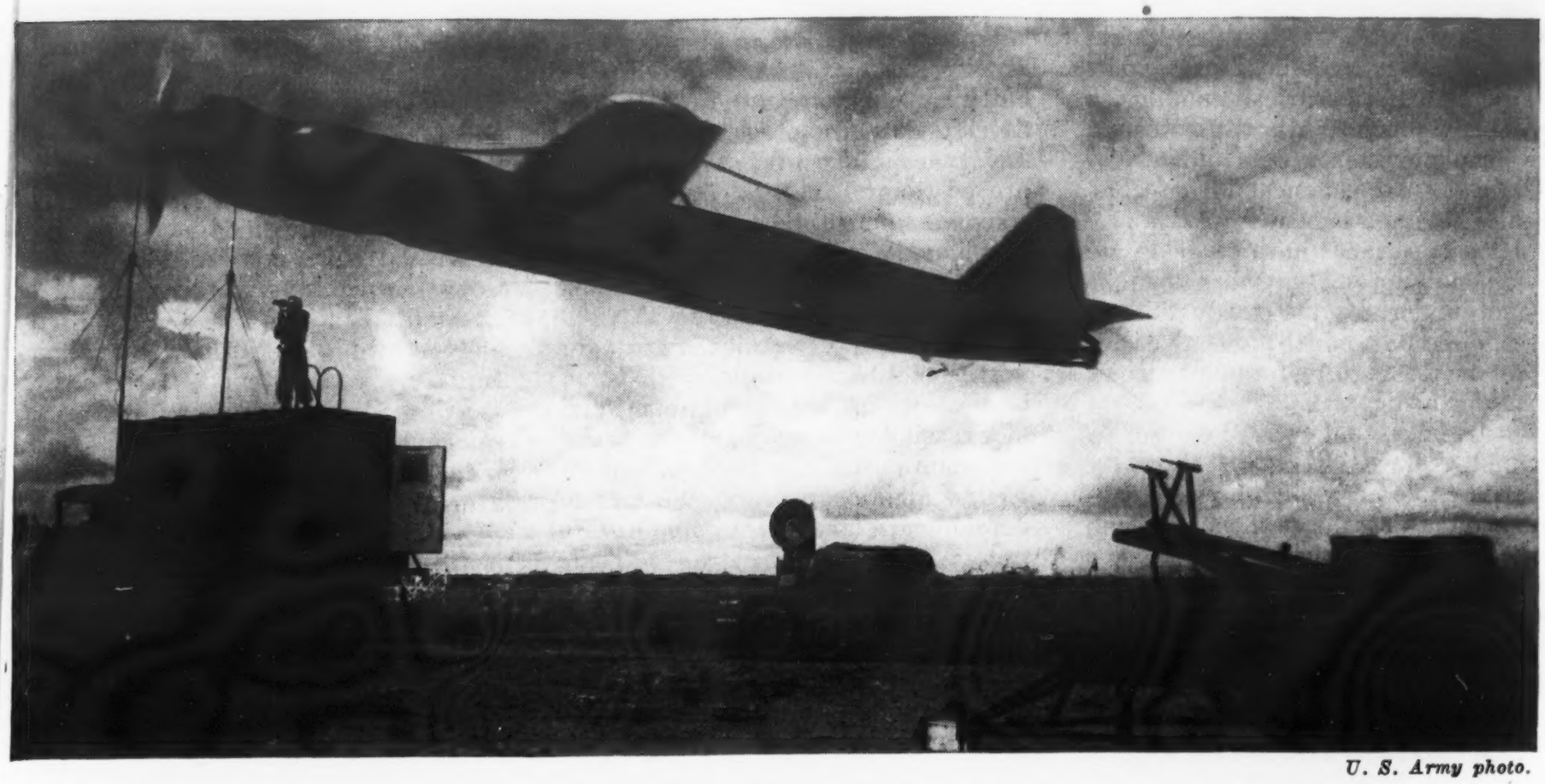
Obviously, at Convair-Pomona, where our primary concern is design, development and production of guided missiles for the U.S. Navy, we must employ electronic and radar engineers who are just as capable as are the other specialists required by our product—in aerodynamics, structures, mechanics, hydraulics, pneumatics, metallurgy, chemistry, and the host of other scientific disciplines represented in our engineering design, test and production rosters.

In fact, if any one thing distinguishes our type of business from that of consumer manufacturing, it is the depth of engineering force we are required to maintain and to develop. As weapon designers, we have to have capability in all of the engineering areas affecting our products, not just in a selected few.

If the weapons are to function properly, we must have good electronics men at the outset of the design phase. Electronics are an integral and often determining design factor, not a superimposed accessory added after the aircraft or missile is created. All the missile or aircraft elements must dovetail into a single working whole.

It should be equally obvious that no aircraft or missile producer would

(*Continued on page* 10)



U. S. Army photo.

Aerial drone being launched in test at Fort Huachuca. Remotely controlled by van equipment, it serves as a "flying camera" to spot enemy movements and installations.

U. S. ARMY SIGNAL CORPS DEVELOPS ELECTRONICS FOR ATOMIC-AGE AT FORT HUACHUCA PROVING GROUND

Fort Huachuca, once a sleepy cavalry post, has come of age in the last few years. When the United States Army Electronic Proving Ground was established here in early 1954, this mile-high post was set upon a new trail marked by electron tubes, transistors, radar antennae, and television cameras.

Nestled against the base of the rugged Huachuca mountains about 100 miles south of Tuscon, its 70,000 plus acres are a beehive of electronic activity under United States Army Signal Corps direction. The many types of different terrain are ideal for the testing of electronic equipment.

Nearly 5,000 military personnel and approximately 2,000 civilian employees, many of them highly skilled scientists, are engaged in work at the Proving Ground.

The new look in defense is placing heavier burdens on the United States Army Signal Corps. This, of course, means more communications with new doctrines suited for employment in atomic war. The Combat Development Department at the Proving Ground has been experimenting along these lines. A new area system of battlefield communication designed to meet the threat of mass destruction from nuclear attack is now in the planning stages.

Meanwhile, the Signal Communications Department is conducting tests on both standard and experimental United States Army Signal Corps equipment to determine their future with the new look in defense. Under atomic attack, the use of extensive wires will not be practical. More radio communication is the answer, but ways to put more channels on radio frequency must be found.

With the spread-out of troops under atomic attack, increased surveillance of combat areas is a necessity. The Combat Surveillance Department of USAEPG is presently developing and testing a surveillance system with devices on the ground and in the air to bring reconnaissance and fire control information to the field commander.

Another important Proving Ground product is the "Flying Camera." A high speed camera is mounted in the fuselage of a remote-controlled drone aircraft. The aircraft is launched into the air by means of jet assist. When its mission is completed, the drone parachutes to the ground near the original launching site. Its up-to-the-minute pictures are developed, and the troops proceed to hit the pin-pointed areas of resistance.

These are just a few of the many projects under way at Fort Huachuca, helping to keep our country's military offense and defense the world's best.

want to undertake the costly and highly specialized assembly-line production of all the electrical and "black box" components in a given weapon or weapon system if he could readily obtain these components from companies having a long and capable production experience in these fields. He would not do this anymore than he would undertake the production of specialized machine tools that his plant might require for a particular manufacturing task.

Sometimes, however, because he cannot reasonably obtain elsewhere the close-tolerance, high-precision devices on which the performance and reliability of his missile depend, at a price within allowable limits, the aircraft-missile manufacturer is compelled to design and produce the components himself.

But it is also a matter of Convair policy that, wherever possible, the production of these components—and in many cases the detailed design work also—is subcontracted to established competent electronics manufacturers or manufacturing in other fields. The procurement of "black boxes" normally goes outside the missile-aircraft industry, unless the missile-maker's quality, tolerance or durability requirements are so rigid as to be beyond the available capabilities of the electronics' manufacturers.

Convair, in short, is not only a producer and designer of airframes for aircraft and missiles but also is responsible for seeing that the electronic, hydraulic, pneumatic and all other systems are integrated satisfactorily and reliably into these airframes.

A good reason why the aircraft-missile industry's requirements are so much more exacting—and therefore sometimes exceed the capacity of some of the electronics industry to produce missile and aircraft components—is that these high-performance weapons subject their components to vibrations, G forces and environmental conditions much more severe than those to which the electronic industry normally has been accustomed.

The Convair Terrier missile, for instance, contains only specially processed and reliable vacuum tubes. These were developed by the electron tube manufacturers to meet our special requirements for components of unusually high quality. To install such tubes in an ordinary television circuit would be a wasteful luxury, but to install less reliable and lower-quality tubes in the Terrier would tremendously increase the likelihood of missile malfunctioning and would increase the total cost.

Potentiometers are another example of Convair's extraordinary needs. We build some of our own and had to develop our own precision manufacturing techniques for this when it proved impractical to obtain fully adequate potentiometers from our suppliers. We intend to get out of the potentiometer business as soon as it is possible.

To eliminate circuit failures or missile malfunctioning caused by vibration, we are developing a method of encasing electrical harnesses and connectors solidly in plastic by an injection molding process. We had to develop correlary fluoroscopic inspection procedures to assure fail-safe harnesses and plugs. Inspection of these assemblies after potting in plastic proved impractical by other means.

Soldering is one of the large manufacturing operations at Convair-Pomona. One and a half million direct manhours are spent on soldering alone. Each missile has approximately 8,000 soldered joints. More than 60 per cent of these joints cannot be adapted to automated printed circuitry, but we intend in the near future to produce 40 per cent of the Terrier's circuits semi-automatically. To accomplish this, we had to develop our own new techniques of etching and automatieally soldering our printed circuits. Better reliability was one of the most compelling reasons why we turned to semi-automatic circuitry production for the Terrier missile. We could not obtain the quality we needed elsewhere or by other methods at prices we could afford to pay.

With the advent of new and faster missiles, we are likely to encounter temperatures so high we can't use conventional solders and must develop really high-temperature materials for this purpose.

Electronics Concerns

In the hypersonic missiles of the future, 65 per cent of our development effort at Convair-Pomona will be electronic engineering, with the remaining 35 per cent apportioned among structural, mechanical and hydraulic engineering.

At Convair-Pomona, 56 per cent of the engineers on our payroll today are concerned in some way with electronics. At Convair's other missile division—Convair-Astronautics at San Diego, California, where the Atlas Intercontinental Ballistic Missile is in pilot production, the proportion is 20%.

At Convair-SanDiego, where aircraft is the dominant product, approximately 25 per cent of the qualified engineers are working in electronics. More than half of these are engaged in research and development and the remainder are scattered throughout the division's other activities.

To broaden its electronic base and to diversify its corporate structure, Convair's parent corporation, General Dynamics, in June 1955, acquired and merged with Stromberg-Carlson Company, one of the Country's leading producers of telecommunications, sound equipment and military and industrial electronics. Stromberg is a great addition to our family and a fine organization, but this does not change the need for, or the use of, electronics people at Pomona or San Diego.

Electronics is truly becoming one of the most dominant—if not the single most important—aspect of our industrial output. No forward-looking company engaged in production of weapons for the military today can overlook the development of its electronics systems engineering capabilities to the maximum and still hope to remain in the competition; whether the parent company carries an airframe and/or electronics label, the needs for successful weapons system development for our Country are the same.

The anxiety I mentioned in the opening paragraph is largely unwarranted. Much of the concern has been generated by defense spending reduction and a feeling of panic that has resulted. I do not believe, for example, that the aircraft industry intends to get into the electronic parts business. Actually, the aircraft and electronics industries have much more in common than do some of the other major basic industries that have entered the electronics and the missiles fields in the past ten years.

In conclusion, I would like to reiterate one major premise. Those of us in the airframe-electronics industry must work together to strengthen our capabilities to produce these weapons' systems. We must maintain high standards of reliability and at the same time we must build these standards within a framework of low cost production. As I have already stated, we at Convair-Pomona are not interested in doing all our own electronics design and production if we can find a suitable subcontractor who can do the job within our high quality control and performance standards.

This then is our challenge. Let us unite the aircraft and electronics elements and meet this challenge together. Let us pull together as "associates".

the New South and SOUTHERN BELL

by HARVEY G. BOOTH
Vice President
Public Relations,
Southern Bell
Telephone & Telegraph Co.

THE SOUTH OF THE STORY BOOKS is no more. Forever "gone with the wind" is King Cotton and the picturesque mode of life he nurtured.

Plantations have given way to factories; forest lands have been transformed into housing subdivisions, and farm-to-market roads have been widened into super highways busy with commerce.

The South is changed and changing. It is in a period of transition which began on the eve of World War II and which has no end in sight.

Like the rest of the Nation, the Dixie states are growing. But the South's advancement appears to be of a different sort from the change occurring generally throughout the United States during these times of great population growth and prosperity.

Perhaps the best way to describe it is to say that the South is experiencing not just growth as such. It is not merely increasing in the things it already had. The growth is not simply the addition of more people, more factories, more production. The transition in the South is a growth in quality more than quantity, a growth that has roots deep in human progress as well as material progress.

The significant factor in the South's evolution is one of upgrading. There has been a substantial increase in income per capita. There is better education per capita. And, most important, there is a higher standard of living.

All people in Southern Bell Telephone and Telegraph Company—whatever their jobs—are interested in and affected by the South's metamorphosis. From it has come a continuing demand for more telephone service. It means more calls to handle, more applications for new service, more installations and changes, more construction work, more capital to raise and invest.

Just how much has the telephone business been growing in the South?

At the beginning of 1946, Southern Bell had 1,863,204 telephones in service in the nine states where it operates—Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina and Tennessee. Now, a little more than 11½ years later, there are approximately 5,590,000 in operation.

This gain represents an increase of about 3,727,000 telephones just since the end of the war, a growth of 200 per cent. Among the other Bell System companies in other parts of the Nation, taken altogether, there has been a 119.3 per cent increase in telephones over the same period.

To describe the growth in another way: the company now has three times as many telephones in service as it had 11½ years ago. And the gain over the past 5½ years alone exceeds the total number of telephones in service upon the company's 65th anniversary in 1944.

The company's growth has been far more than had been forecast earlier for the nine states. In fact, advance estimates of economic growth for almost all businesses in the South since the war have been far too conservative, and economists continually have had to raise their sights about Dixie during the last decade.

It is doubtful any prophet could have predicted the expressed desire or "demand" for telephones that has occurred in this postwar expansion. Yet Southern Bell has taken care of 99.4 per cent of all applications for service which have come to it during this period. At the present time about 61 per cent of the households in areas served by Southern Bell have telephones. At the beginning of 1946 only about 31 per cent had telephones. The demand still is continuing at a heavy pace.

To provide facilities for this continued and unprecedented increase in telephones, Southern Bell expects to spend, during this year alone, over $1,000,000 each working day in constructing telephone facilities, or a total of almost $300,000,000.

Southern Bell now operates 1,082 exchanges in a territory that covers 50 per cent of the land area of nine states. Through these exchanges on an average business day this year, telephone users are placing an average of over 34,780,000 local telephone calls and almost 919,000 long distance calls.

To operate its vast communications network, Southern Bell employs about 70,500 persons. In contrast, 11½ years ago, the company had 36,731 persons on its payroll.

At the present time, 90 per cent of the telephones in the Southern Bell area are dial-operated. And almost 56 per cent of the long distance calls originating in Southern Bell exchanges are dialed directly by operators.

In December of this year two cities—DeLand, Florida and Waycross, Georgia—are scheduled to begin use of customer direct distance dialing, for which equipment now is being installed. These will be the first Southern Bell exchanges to have the service. Meanwhile, over one-third of Southern Bell telephones use the "2-5" numbering system, designed to fit into the nationwide plan for direct distance dialing.

Just as Southern Bell has benefited from the progress in the South, it has contributed to that progress. This year the company will pay an estimated $285,000,000 in wages. And taxes to be paid to local, state and federal governments will amount to about $137,235,000. In addition, the economy of the area has been affected favorably by the company's phenomenal construction program which has resulted in the expenditure of over $2,000,000,000 since the end of 1945.

Despite all the changes in the area's economy, the people of the South feel that the region has not yet reached a state of full development and that there are possibilities of still further growth.

Southern Bell has complete faith in the South and its dynamic growth and potential. And the company hopes to be able in the years ahead to continue providing in full measure the telephone service to help in that progress.

Transmitter klystrons for microwave communications

10-watt SRL-7 series
reflex oscillator klystrons for 1700-1930, 1850-2100, 1930-2160, 2160-2400 mc

SRL-7 SPECIFICATIONS

	SRL-7F	SRL-7C	SRL-7G	SRL-7H
Frequency Range	1700-1930 mc	1850-2100 mc	1930-2160 mc	2160-2400 mc
Output Power	7-10 w	7-10 w	7-10 w	7-10 w
Modulation Bandwidth	20 mc	20 mc	20 mc	20 mc
Modulation Sensitivity	63 kc/v	70 kc/v	87 kc/v	84 kc/v

Designed primarily for telephone, teletype, telegraph and TV transmitting applications, the Sperry SRL-7 series reflex klystrons are also ideal for laboratory use in test equipment and bench oscillators. Important features include extended service life running into thousands of hours, outstanding ease of modulation, and single-screw tuning. Now in large-scale production, SRL-7 series klystrons are ready for immediate delivery. Phone or write your nearest Sperry district office for data sheets on these tubes and other Sperry klystrons for other purposes.

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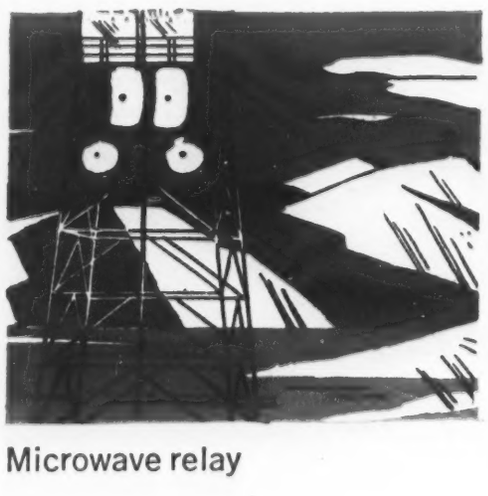
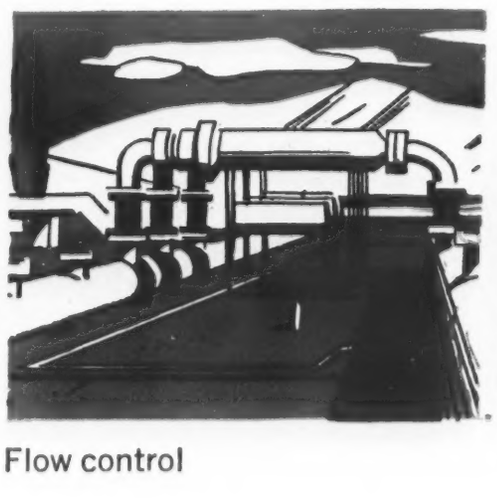
Television transmission



Microwave relay

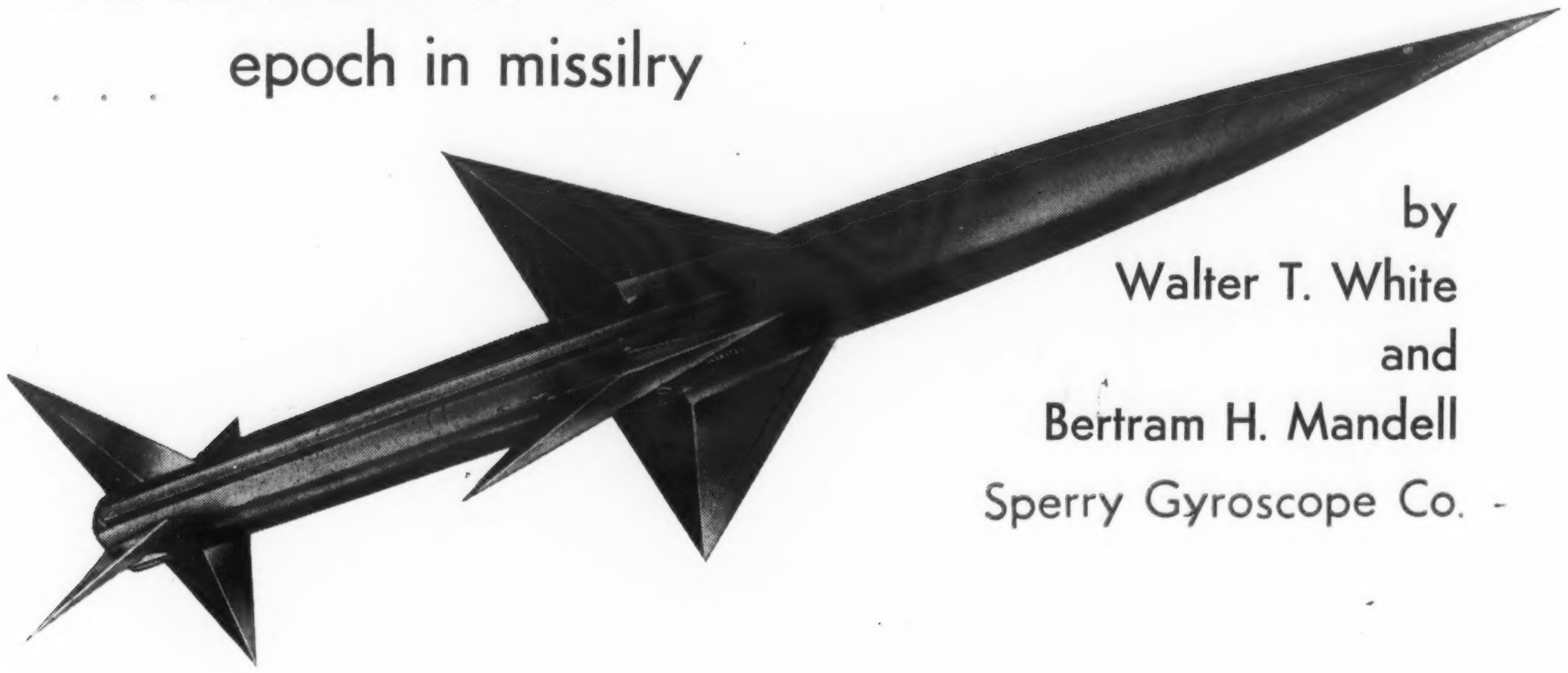


Flow control

Battlefield communications

SPARROW I

. . . epoch in missilry



by
Walter T. White
and
Bertram H. Mandell
Sperry Gyroscope Co.

FIRST AIR-TO-AIR GUIDED MISSILE IN the Nation's arsenal, the Sperry Sparrow I already had reached an advanced status before it was officially announced by the Department of Defense early in 1954. The announcement came after seven years of development by the Navy's Bureau of Aeronautics and Sperry Gyroscope Company. Admiral Arleigh Burke, Chief of Naval Operations, credited "years of intensive development by the Bureau of Aeronautics and Naval Air Missile Test Center, and Sperry for the readiness of the Fleet with this air-to-air missile system."

Developments and Elements

Commenting on the vastness of the technical subjects which had to be mastered in early guided missile development, Rear Admiral John E. Clark, Director of the Navy's Guided Missile Division, has said that "perhaps never in the history of human endeavor had man embarked on a program of such magnitude with so little to base his efforts on. . . . In ten short years, our scientists and engineers had produced guided missiles of amazing performance and reliability." A case in point, the Sparrow I program had to include not only design, development and production of a "bird" consistent with the Navy's peculiar problems of shipboard use, but guidance and test equipments, training of ground and air crews, and the construction and operation of a plant specifically for missile production—all without precedents.

More than 100 prototype missiles had been constructed and critically test-flown between 1948 and 1951, including air launchings from Navy aircraft as early as 1949. Evolutionary models, these missiles were the forerunners of the production Sparrow I missiles now in service with the Sixth and Seventh Fleets of the U. S. Navy. Behind the initial, terse announcement of the first air-to-air missile system, is a pioneering project that began in 1946, when the Sperry Gyroscope Company was authorized to initiate a study program for the development of an air-to-air guided missile capable of intercepting bomber aircraft.

Also involved were preliminary studies and resulting choice of the radar guidance system, missile guidance system and missile aerodynamic configuration. The objective of the Sperry Sparrow I Weapon System was to defend carrier task forces from attack by enemy aircraft through the use of beam-riding guided missiles launched from carrier-based fighters. The probability of attack on Naval forces by high-speed aircraft carrying guided missiles, as well as conventional armament, made necessary the development of this defensive weapon which is capable of relatively long range operation and which has exceptionally high single-shot probability of kill. The major operating elements of this weapon system are: (1) An aircraft carrier which serves as a mobile base and directs a fighter to the vicinity of the target; (2) The fighter squadron; (3) The missile carried by the fighter; (4) The fighter fire control system which indicates the course to be followed by the fighter; (5) The fighter radar set which transmits the beam which guides the missile, and which furnishes data to the fire control system for determining the course to be followed by the launching aircraft.

In addition to these operational elements, other items essential to system operation, such as test equipment, maintenance bases, logistical support and personnel training programs, are parts of the Sparrow I Weapon System.

Components

A major element of the Weapon System, the Sparrow I is a supersonic air-to-air, beam rider type of guided missile. The missile consists of a fuze and warhead, a source of hydraulic and electrical stored energy, a guidance system and a rocket motor, all packaged in an 8-inch diameter, 12½-foot cylindrical body with a pointed ogival nose. The arrangement of wings and tail fins is a cruiform configuration and provides for missile maneuverability in any direction without the necessity of banking the airframe for a turn, as with

The first air-to-air missile in the Nation's arsenal, the Sparrow I has seen service with the Navy's Sixth and Seventh Fleets. Until now, the only information re-

conventional aircraft. The assembled missile weighs about 300 pounds.

Arming The Fighter

The Sparrow I is carried externally under the wings of jet fighter aircraft. The fighter is equipped with airborne guidance radar and is armed with four missiles. These jet aircraft operate from both carriers and shore bases and are effective at all operational altitudes against high-speed jet bombers, fighters and certain missiles.

In tactical flight operations, enemy aircraft are picked up by the airborne radar and Sparrow I missiles are launched by the fighter and controlled by a guidance system that "looks through clouds" and places the missile squarely on the target.

Guidance And Control System

The guidance and control system provides the capability for the missile to alter its flight path and intercept an evasive target. Elements of the system function as the brains, nerves and muscles of the guided missile. The initial flight path for Sparrow I is controlled by inertial elements which include both accelerometers and gyroscopes. The later phase of flight for Sparrow I is controlled by beam signals, and the missile follows the axis of the radar beam to the target.

The principal elements of the guidance and control system are:

(a) Multi-axis gyroscopes and accelerometers.

(b) Missile antenna and receiver for detecting the intelligence in the guidance beam.

(c) Missile computing circuits to shape the signals to obtain precise and stable beam riding.

(d) Servomechanisms for positioning the wings of the missile as required for maneuvering in flight.

These elements are packaged in a number of unitized separate assemblies in order to facilitate manufacture, test and field servicing. Both the mechanical and the electronic components are packaged to form complete functional assemblies. This greatly facilitates the preparation of specifications on a logical basis for each element, and it simplifies system checkout and maintenance for the missile.

Extensive flight tests have shown that the complete assembly is highly reliable under the rugged environmental conditions of missile launching and flight.

Power Supplies

The power supplies for Sparrow I include battery sources for electrical energy and a high-pressure hydraulic accumulator for the mechanical energy required to position the wings. Both supplies are designed with adequate capacity to furnish the energy required for the duration of the flight of the missile.

Sparrow I Rocket Motor

The rocket motor is the source of energy which provides the thrust that gives the missile the velocity increment over its launching speed. Thrust on the missile in the forward direction results from the reaction of the hot gases ejected at high velocity.

The motor is packaged to form a smooth cylinder that is a section of the missile's body. It consists of three major components; namely, the case, the propellant grain and the igniter assembly. The case is a thin-walled metal cylinder with an attachment mechanism to the forward section of the missile, and with a nozzle which directs the high-velocity gases aft. The high-energy propellant uses solid concentric grains with a plastic base which burn uniformly, and thereby gives a steady thrust to the missile. The chemical composition of the grain provides an oxidizing agent, and therefore, burning rate essentially is independent of altitude.

The igniter assembly fits into the forward section of the motor and is triggered by an electrical impulse. The grain of the motor is fired in a fraction of a second by action of the igniter and a large uniform thrust is generated immediately.

Warhead System For Sparrow I

The purpose of the warhead system is to provide the maximum probability of kill when the Sparrow I intercepts the target. The kill must be positive and immediate in order to eliminate the possibility of a crippled enemy aircraft completing its bombing run before crashing into the sea. With this as an objective, a significant part of the missile's weight and volume is allocated to this payload.

The warhead assembly for Sparrow I includes three major elements; namely,

(a) The safety and arming mechanism which provides positive safety of life for ground, shipboard and flight personnel under all conditions of environment and handling.

(b) The fuze which detonates the warhead at target interception.

(c) The warhead which includes an igniter and explosive assembly which, when detonated, will kill the target.

Flight Of Sparrow I

The Sparrow I missile is launched when the pilot of the fighter aircraft closes the firing switch. This action sends to the missile an electrical pulse which ignites the rocket motor. The resultant thrust propels the missile forward relative to the launching rack and the missile quickly attains a speed significantly greater than that of the carrying aircraft. By motor burnout, which occurs within seconds after launching, the missile's velocity is twice to three times the speed of sound. This is in excess of 1500 miles per hour. When attacking an enemy target, the missile either is launched singly or several missiles are launched rapidly in sequence.

In flight, the missile has the capability of altering its path by deflecting control surfaces. Initially after launching, the trajectory of Sparrow I is controlled by inertial guidance. In the later phase of flight, the wings of the missile deflect in response to guidance signals from the radar beam which is pointed at the target. Accordingly, it is said that the missile "rides the beam" and Sparrow I is classified as a "beam rider" missile. Because the guidance beam is positioned precisely in the direction from the launching aircraft to the target, the missile is guided along a trajectory which leads to an interception even under evasive action. The accuracy and reliability of Sparrow I in flight has been proven by hundreds of instrumented launchings where precise observations were recorded.

For the production of the Sparrow I missile, Sperry Farragut Company, Division of Sperry Rand Corporation,

leased by the Navy has been quite general. This article is the first to be cleared by the Navy on the design, development and production of a complete missile system.

was organized in June 1951, to build, equip and operate a naval industrial reserve aircraft plant for the Navy's Bureau of Aeronautics.

The plant, fully air-conditioned and including an electrostatic air-filtering system, consists of an enclosed factory, laboratory, service and office areas totaling 537,000 square feet.

The factory was laid out essentially on a production flow basis with raw materials and purchased parts received at one end of the factory floor and finished products shipped from the opposite end of the building.

Missile Manufacture

Sparrow I production by the Sperry Farragut Company, at Bristol, Tennessee, consists of the manufacture, inclusive of factory test, of the complete guidance and control section, electrical and hydraulic power assemblies, and the airframe of the missile. The rocket motor, fuze and warhead, which comprised the balance of the missile configuration, is procured by the Navy directly from other prime contractors for eventual assembly to guidance and control, and power sections at naval field installations or aboard ship.

Factory layout provides for a purchased material holding and checking area inside the plant. From this area, entire lots are routed to adjacent incoming material quality control stations for inspection and test. Completely equipped mechanical inspection, electrical test, and materials testing laboratories in the plant varified conformance of incoming material with purchase specifications.

The detail parts of the missile include not only commercially available items such as hardware, resistors, capacitors and tubes, but also many parts designed specifically for Sparrow I. Accordingly, the machine tools and production equipment in the plant are devoted largely to the manufacture of the special detail parts. The fabrication of these parts involved machining of castings and forgings, turning, and sheet metal work.

To facilitate operations on the major categories of machining work, two principal machining areas were established. These are designated, respectively, as the "casting line" and the "turning line." The sheet metal shop handled the relatively small volume of punch press and sheet metal extrusion work required for missile parts.

Airframe shells are machined in a special area that is tooled to handle the relatively larger aluminum and magnesium castings and extrusions from which the control and hydraulic power sections of the airframe are fabricated.

Although the majority of transformers required for the missile are sub-contracted to capable manufacturers in this field, a critical group of transformers is manufactured in the plant, as are all required special coils and gyroscope stators.

Assembly, Inspection And Test

Purchased and manufactured detail parts are released from stores to the assembly lines and areas in quantities and types compatible with the block of missiles to be manufactured. Manual assembly lines and areas are established for distinctive types of work, i.e., electrical assembly, wire preparation, transformers and coils, assembly of gyroscopes and hydraulic assembly. Within the electrical assembly area, separate lines are established for the production of individual units, such as servo amplifiers and guidance amplifiers.

Gyroscopic and hydraulic assembly, inspection, and test operations are conducted in "super-clean" enclosed areas established exclusively for such work.

Final missile assembly is effectively keyed to the receipt of components from the respective lines and areas. To this extent, all component assembly lines served as "feeders" for the final missile assembly line and components are stocked at the latter line rather than in a separate storeroom. Overhead materials-handling equipment is employed to facilitate final missile assembly and delivery to and from system test.

Final missile production testing is conducted on all missiles in a sequence which provided for both static and dynamic performance checks before, during and after exposure to simulated firing shock and flight vibration. Several missiles from each month's production are selected for comprehensive environmental tests following the initial factory acceptance tests. These "samples" are subjected to altitude, temperature, and vibration tests in the plant's environmental laboratory. Additionally, missiles are also selected each month for air launching at the Naval Air Missile Test Center and achievement of a specified high reliability and accuracy is a further condition of final acceptance of production output.

Reliability And Quality Control

Missile reliability engineering and production quality control efforts are closely coordinated to provide an effective system of factory and field failure reporting and analysis.

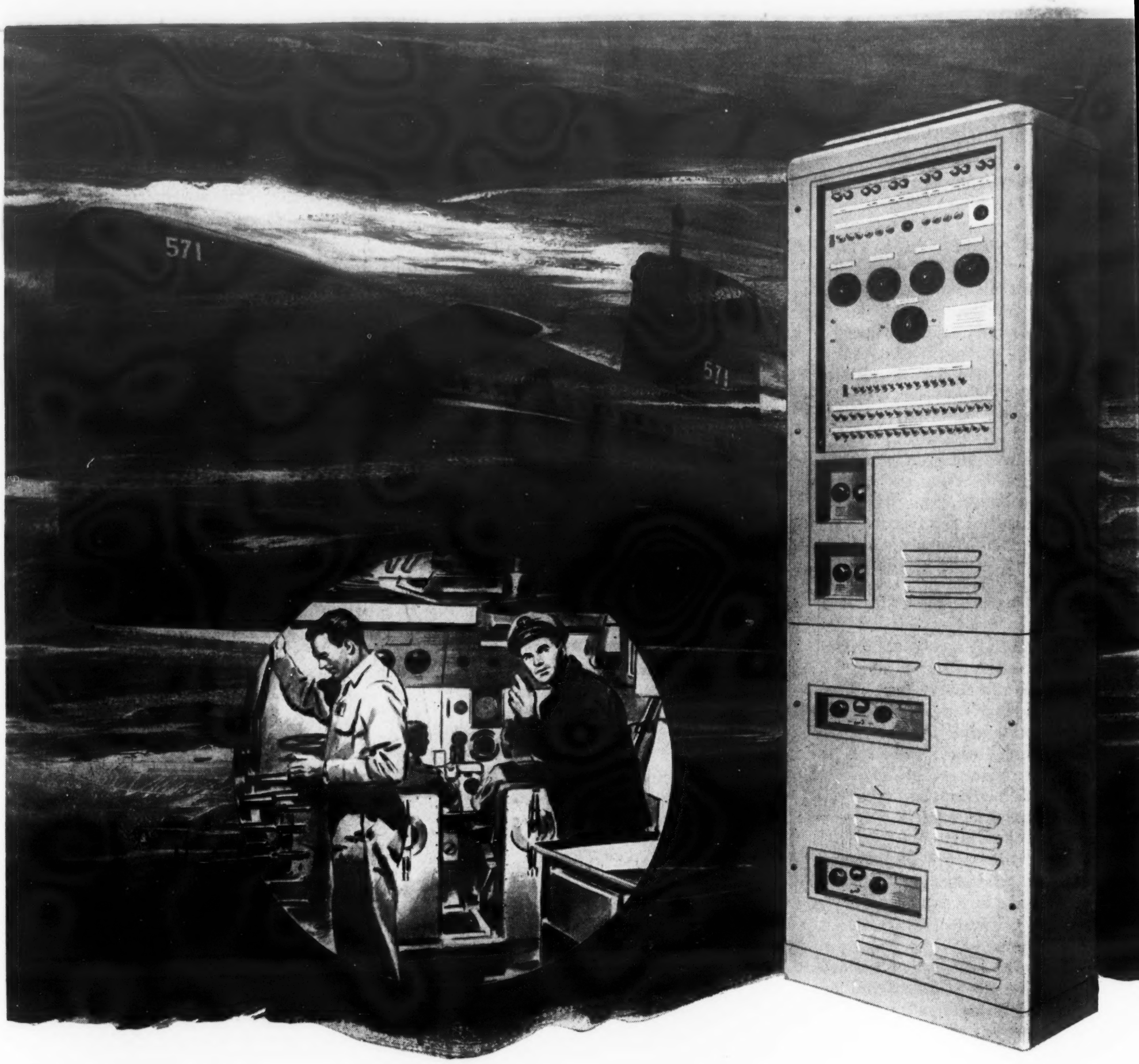
The quality control policies and practices employed in the production of Sparrow I missiles directly reflected management's keen awareness of the quality requirements which are essential in the production of reliable guided missiles. In recognition of the severe environmental conditions and unusually high reliability requirements in a guided missile, purchased functional components, such as potentiometers, resistors, capacitors, and relays, are 100% tested to specifications before acceptance for product use. Electron tubes are 100% microscopically and electrically tested before and after a combined burn-in and vibration cycle.

To insure uniform and efficient checking for conformance with specifications, all inspection and test operations are performed in accordance with detailed check lists and procedures. Continuous direct liaison between inspection and manufacturing supervision, as well as weekly summary reports, assured prompt action to correct below standard workmanship trends.

The Sparrow I marks an epoch in missilry. The system represents a major accomplishment in guided missiles by the U.S. Navy and Sperry. Significant steps in the program include conception and design of the missile and its guidance system, prototype missile manufacture and successful flight test, construction and operation of a plant specifically for missile production, and service evaluation and acceptance of the production Sparrow I Weapon System.

The major objectives of the project have been to achieve an effective weapon system with an accurate and reliable missile designed to be manu-

(*Continued on page* 51)



To voice the world's newest submersibles

The shipboard and battle-announcing needs of a submarine pose problems that just "standard" equipment can't meet.

Exceptional ruggedness is required, both to withstand shock and to resist heat, humidity, and salt moisture.

Power must be adequate, yet compressed into the smallest possible space.

Dependability is relative to such factors as cruise distances never before attempted by underwater craft.

An example of products meeting such problems is found in the announcing equipment aboard the atomic-powered *Nautilus* and *Seawolf*, built by our associate division, Electric Boat, and "voiced" by Stromberg-Carlson. Here standard components were re-designed to the special conditions involved. On the *Nautilus*, to date, our equipment has logged more than 60,000 nautical miles without difficulty of any sort.

Similar equipments also serve the land and air arms of our country's military forces and give evidence of equal dependability under the special conditions for which they were designed.

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Editor's Note:

The quality control standards, as established by Captain Richards in this article, have received recognition from the U. S. Air Force and are now in use by the National Security Agency, Strategic Air Command and the Air Materiel Command. Recently Captain Richards received special commendation for his work from Headquarters, Airways and Communications Service.

QUALITY CONTROL *of the* STRATCOM SYSTEM

by Captain Maxwell J. Richards, USAF
Headquarters AACS,DCS Comm.
Andrews Air Force Base

THE MORE ACCURATE NAME STRATCOM, WHICH HAS replaced the familiar term GLOBECOM, stands for the United States Air Force Strategic Communications System. It consists of interconnected Air Force radio stations, leased or allocated long haul wire and radio channels, terminal equipment, relay facilities, communications centers, cryptographic centers, etc. It does not normally include internal, tactical and special-purpose communications systems of the various commands below the major command level.

Actually, the STRATCOM System is the United States Air Force point-to-point, long-haul communications pipeline. It is composed of several integral parts such as the USAF Communications Network (AIRCOMNET), which provides a system for passing official teletypewriter traffic in support of USAF air operations on a global scale; the USAF Air Operations Network (AIROPNET), which provides a system for passing flight service and other aircraft movement messages between selected locations; Weather Teletypewriter and Facsimile Networks and others. Headquarters USAF determines and modifies the structure of the STRATCOM System on the basis of USAF operational requirements; however, Airways and Air Communications Service (AACS) is responsible for engineering, installing, operating and maintaining the system.

The STRATCOM System encompasses both the voice and the printed information media. Quality control of the STRATCOM voice system is relatively simple since the landlines are engineered four-wire circuits. These circuits arrive at each STRATCOM single sideband C-3 Control Terminal at —9 db and the single sideband equipment is quality controlled by use of the signal-to-noise ratios illustrated in figure 1 (page 18).

The STRATCOM printed information system is quality controlled through the technique of total distortion measurements. For example, it is the objective of AACS to have a teletypewriter signal arrive at receiving tributary stations with not more than 10% total distortion, regardless of the type of transmission path or the point of origin.

(*Continued on page* 19)

SIGNAL TO NOISE RATIO	MERIT RATING	GRADE OF PERFORMANCE	ACTION REQUIRED
Above +25 db	M-5	Excellent	None.
+21 db to +25 db	M-4	Good	None.
+16 db to +20 db	M-3	Marginal	Constant attention by technical control; investigate potential sources of trouble.
+ 5 db to +15 db	M-2	Poor	Channel not usable for customer-to-customer transmission; investigate sources of trouble and transfer channel to maintenance where applicable.
Below +5 db	M-1	Unusable	Channel not usable for customer-to-customer transmission; investigate sources of trouble and transfer channel to maintenance where applicable.

Figure 1. Quality Standard for Single Sideband Radiotelephone Service.

TYPE OF OPERATION	TOTAL DISTORTION OF INCOMING SIGNAL FROM DISTANT END	ACTION REQUIRED
Relay-to Relay and Relay-to-Tributary Station.	Less than 5%	Circuit acceptable; no action required.
	Between 5% and 10%	Marginal; monitoring required.
	Above 10%	Seize circuit if constant for two minutes; investigate transmission path and equipment.
Tributary to First Relay Having a CTCF.	Less than 10%	Circuit acceptable; no action required.
	Between 10% and 25%	Marginal; constant monitoring required.
	Above 25%	Seize circuit if constant for two minutes; investigate transmission path and equipment. Source of trouble must be eliminated prior to restoring circuit to traffic.

Figure 2. Quality Control Standard for Non-Cryptographic and Off-Line Cryptographic Operation.

DISTANCE	TOTAL DISTORTION OF INCOMING SIGNAL	ACTION REQUIRED
FROM POINT OF ORIGIN TO DISTANT RECEIVING STATION	Less than 5%	Circuit acceptable; no action required.
	Between 5% and 10%	Marginal; constant monitoring required.
	Above 10%	Seize circuit if distortion is constant for two minutes; investigate transmission path and equipment. Source of trouble must be eliminated prior to restoring circuit to traffic.

Figure 3. Quality Control Standard for On-Line Cryptographic and Transceiver Data Link Operation.

TYPE OF DISTORTION	TYPE OF EQUIPMENT	QUALITY STANDARD: TRANSMITTING TOLERANCE	QUALITY STANDARD: RECEIVING TOLERANCE
BIAS	Transmitter-Distributor TT-21 or XD-86 class and the AN/TGC-1, AN/FGC-38 and AN/FGC-39 class	3%	
Switched Combination produced by the 119C1	Page Printers and Reperforators		30 to 35%
Bias (Transmit) Switched Combination produced by the 119C1 (Receive)	Crypto Devices (SSM-3, SSM-33, TT-160/-FG, etc.)	3%	25 to 30%
Total	Relays	3%	
Fortuitous*	Electronic Devices	3%	
Fortuitous*	VF Carrier Channels	3%	
Fortuitous*	Keyboards of M-15, M-19, or M-28	4%	
Fortuitous*	Transmitter-Distributor TT-21 or XD-86 class and the AN/TGC-1. AN/FGC-38, and AN/FGC-39 Class	3%	

*This fortuitous distortion is the peak figure for a two-minute sample of random keying.

Figure 4. In-Station Quality Standards.

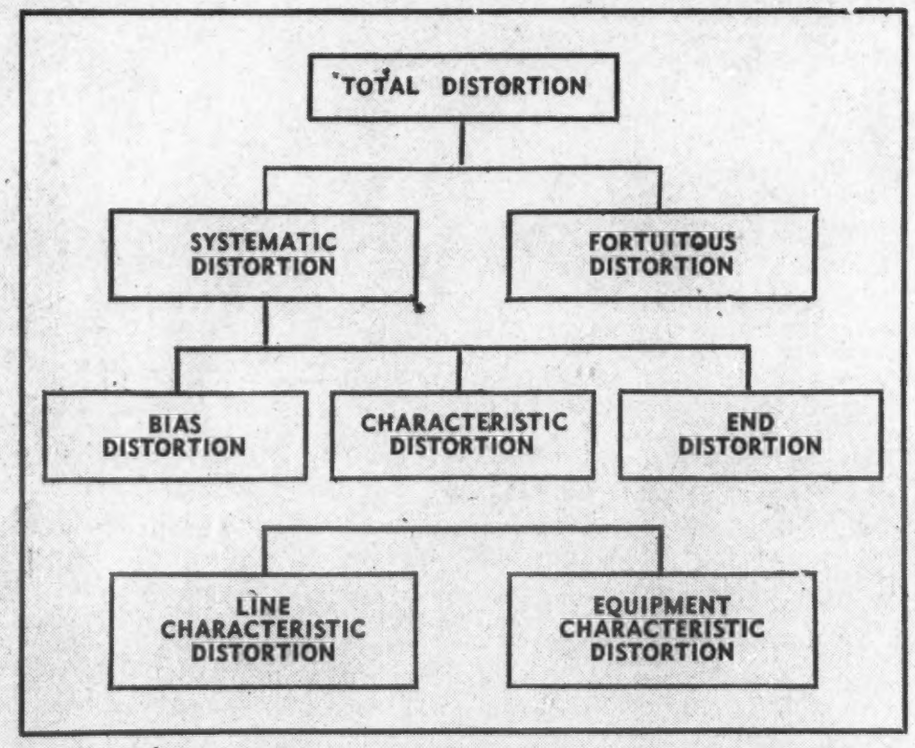

Figure 5. Components of Teletypewriter Distortion.

Relay-to-relay operation within the STRATCOM System can meet this requirement today; however, many Air Force Tributary stations cannot. Figure 2 is a table of the quality standards used for clear text and off-line cryptographic operation within the STRATCOM System. Since a signal from a tributary station is permitted to arrive at the first technical control point (CTCF)[1] with a maximum of 25% total distortion[2], it must be regenerated or reperforated before it is transmitted to either another tributary or to the distant relay. This is necessary since the signal must arrive at the distant end at not more than 10% total distortion. Although 25% total distortion arriving from a tributary is acceptable for clear text and off-line cryptographic operation, it is not acceptable for either on-line cryptographic or transceiver data link IDP (Integrated Data Processing) radio transmission. On-line cryptographic equipment and transceiver data link equipment will not stay in "set" when the total distortion on radio circuits exceeds 10%; therefore, Figure 3 is the Air Force standard for these two techniques.

The quality standard illustrated in Figure 2 is used by all STRATCOM technical controllers as the quality standard for all off-line and clear text traffic arriving at their station. However, these controllers also use in-station standards which are illustrated by Figure 4. These in-station standards are used when a technical controller looks back into his own STRATCOM relay equipment. If the equipment being tested exceeds the limits prescribed in Figure 4, it is defective and is not used for traffic.

Although AACS bases its printed information quality control standard on total distortion, an understanding of the components of total distortion is essential in order to interpret the STRATCOM System performance. This requirement becomes apparent when the STRATCOM technical controllers determine trouble locations on transmission paths used for transceiver data link and on-line cryptographic operation. Figure 5 illustrates the components of teletypewriter distortion as used by AACS; the terms used in this figure are defined below.

Total Distortion: The total of all forms of signal distortion is cumulative and is known as total distortion. A signal having marking bias (all marks lengthened and all spaces shortened) in one link of a teletypewriter transmission system and spacing bias (all spaces lengthened and all marks shortened) in another portion of the system could actually have less total distortion at the distant receiving point than at test points along the system due to the cancellation effects of bias distortion.

Systematic Distortion: The term systematic distortion is used to denote the periodic or constant distortion, such as bias or characteristic distortion, and is the direct opposite of fortuitous distortion.

Fortuitous Distortion: The random displacement, splitting and/or breaking up of the mark and space elements.

Bias Distortion: The *uniform* lengthening or shortening of the mark or space elements, one at the expense of the other.

Characteristic Distortion: The repetitive displacement or disruption peculiar to specific portions of a signal. There are two types of characteristic distortion; line characteristic distortion and equipment characteristic distortion.

End Distortion: A special type of telegraph signal distortion created for testing purposes. It has the effect of advancing or delaying the end of each marking impulse with respect to the beginning of the character cycle or the initial mark to space transition.

The test equipments used today to quality control the STRATCOM System are adequate but cumbersome. Although these equipments are also used in industry, their intent and design is to provide "after the fact" information. A technician today, using these test equipments, is always looking for the trouble after it occurred. This technique is obsolete in the jet age and in its place the Air Force is looking for "before the fact" information. Soon to be incorporated within the STRATCOM System are automatic telegraph distortion monitors and continuity signals recognizers. These electronic units will recognize marginal circuitry prior to its development into an out-of-service condition. In this way, the STRATCOM technical controllers will prevent the unnecessary chaos that accompanies an out-of-service condition. Dials on these distortion monitors will be set at the marginal value of the total distortions indicated in Figures 2 and 3, and alarms will sound when the STRATCOM circuitry degrades to these values. Thus, the STRATCOM System will be quality controlled electronically and will provide the technician with "before the fact" information.

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[1]CTCF is the abbreviation for the Channel and Technical Control Facility which is the unit within a STRATCOM station that is charged with the responsibility of controlling the quality of the System.

[2]Twenty-four percent total distortion is the same as the Bell System coefficient 10.

[redacted]

ALMOST EVERY DAY THOSE OF US IN the electronics field learn of new devices and equipment that radiate electromagnetic energy. We also hear of increased power for radars and vast new high power communications systems. Taken together, these only intensify the already difficult problem of efficient spectrum utilization.

There is only one frequency spectrum, and it is literally bulging with users. From a military standpoint, (Figure 1, page 23), the Army signal system must be compatible with Air Force and Navy systems and at the same time, essential civilian requirements cannot be neglected. On top of this, the enemy can be counted on to provide both intentional and unintentional interference.

Modern warfare will require greatly increased emphasis on communications and non-communications systems. In the Field Army Area, increased requirements are generated by the present day needs for combat surveillance, for the conduct of electronic warfare, for many new types of radars, and for air navigation and traffic control. All these in turn generate a pyramid of additional communications requirements.

In a recent article entitled, "What Price Frequencies" (SIGNAL, January 1957), Major General Alvin L. Pachynski, USAF, very lucidly pointed out ". . . . the solution (to the problem of shortage of spectrum space) lies in the establishment of long term objectives rooted in technological progress and which, among other things, must take equipment obsolescence into account. The successful achievement of those long term goals is dependent on a joint awareness by all of us of the problem that exists today."

This problem is not lessening. It is increasing by leaps and bounds. Moreover, present concepts envision a great increase in the number of electronic devices concentrated in a relatively small area in support of a tactical and strategical operation, which could result in intolerable interference among equipments. Realizing this, the Chief of Research and Development, Office of the Chief of Staff, directed the Chief Signal Officer to conduct a study in order better to understand, measure and control the problem of electromagnetic spectrum crowding. The Chief Signal Officer directed the Commanding General of the U. S. Army Signal Engineering Laboratories at Fort Monmouth, N. J., to establish a project investigating this problem. This effort is known as Project MONMOUTH.

The first phase of Project MONMOUTH (now called Project MONMOUTH I) involved a theoretical study of the electronic complex, considering existing equipments deployed in a tactical situation. Project MONMOUTH I showed a considerable mutual interference problem and came up with recommendations to reduce this interference. This was during the summer of 1955.

With the magnitude of the present problem established, a second phase of the project was started. The objective of Project MONMOUTH II was to attempt to find ways to reduce the areas of interference among electronic equipments in the Army of the future. Considered were:

(1) Better frequency assignment techniques. (2) Optimum balance of frequency allocation versus tactical requirements of the equipments. (3) Communication network systems concepts (including time-sharing and common-user methods). (4) Appropriate methods of modulation. (5) Appropriate propagation techniques. (6) Methods for the design of equipments to result in non-self-jamming. (7) Other means to avoid or minimize mutual intereference.

To meet these objectives, the scope of this study was to:

(1) Survey and estimate systems requirements of the Army of the future. This task required determining the number of channels, distances between echelons, equipment density, employment by the using organization, weight and size limitations, and other limiting factors for the following sub-systems: Air navigation and traffic control, combat surveillance, communications, countermeasures and radar-IFF-missiles. Air Force and Navy requirements also had to be considered.

(2) Synthesize the individual subsystems into an over-all signal complex that will be non-interfering. To be taken into account were such items as frequency allocation engineering, interference criteria, design limitations for future equipments, types of modulation, wave propagation limitations, power requirements, and frequency assignment techniques considering density, location, and tactical deployment of equipment.

(3) Evaluate the signal complex which has been devised for any foreseeable tactical situation. This required analyzing it for non-interference, feasibility, and applicability, in order to present as comprehensive a statement as possible for the nature, degree, and seriousness of any interference and to recommend areas for future study.

A working group representing industry, universities, and Government agencies, receiving technical and administrative guidance from USASEL, was divided into sub-groups to study various aspects of the problem. These sub-groups set about the task of systematically proceeding from a description of future tactical concepts for a field army to a detailed analysis of the spectrum utilization problem.

The method of solution used in Project MONMOUTH II is shown in Figure 2 (page 23). The study started with certain facts shown as "Givens" which included information on tactical concepts of our own forces and of enemy forces, and a knowledge of environment in which the system would have to function. A detailed study was made of communications and non-communications requirements from the organizational and operational complex of the future Field Army. If one could listen in on the conversation of the group considering the operational requirements of a communications system, one would

The signal complex for the future field army will not suffer intolerable mutual interference if thorough systems planning and engineering is conducted by

hear such expressions as "need lines," "call-minutes" and "link lengths." Important areas of consideration included traffic analyses, circuit loading and the number of voice channels.

In the non-communications group, the sub-group considering the air navigation and traffic control requirements discussed such functions as within army area air lifts, area casualty evacuation, aerial observation, close support, and operational requirements in terms of volume of traffic, urgency, type of aircraft and distances to be covered. Other sub-groups considered the operational requirements of their own sub-systems and made similar investigations and studies.

At this point in the solution, the systems concepts to satisfy the communications and non-communications requirements were considered. For communications, the pros and cons of area coverage radio relay and radio central systems, net systems, and point-to-point systems were developed. In choosing the system to match the desired service, no single concept completely satisfied the communications requirements of the future Field Army. Therefore, a number of systems capable of handling the communications requirements of the combat and support organizations were integrated.

The Systems Design Group concerned itself with the more basic, generalized phases of an integrated signal system, many of these aspects having been previously enumerated in the objectives of Project MONMOUTH II. The group was divided into sub-groups to consider various aspects of the problem, such as: propagation and systems, design limitations, interference criteria, field tests, spectrum allocation, and frequency assignment techniques.

Factors attendant to good systems design are interrelated. For example, it is difficult, if not impossible, to separate frequency stability from type of modulation, the type of modulation from the mode of wave propagation, and so on right down the line.

As an illustration of the types of studies conducted by these sub-groups, let us look at what personnel concerned with propagation and systems investigated. Studied were such factors as: general propagation characteristics such as use of higher frequencies for short range transmissions and lower frequencies for long range transmissions; special modes of wave propagation such as ionospheric scatter, tropospheric scatter, and obstacle gain transmissions; and non-line-of-sight transmissions via irregular terrain propagation. Atmospheric noise, cosmic noise, and man-made indigenous noise, as it may be realized by our future field army, were studied to assess the effect on receiver sensitivity and power balances of systems to be exploited. Suitability of various types of modulation to the mode of propagation and system concepts were studied. Transmitter power and antenna characteristics required to provide the necessary degree of systems reliability over the distances desired were also established within the size and weight limits imposed by future tactics.

What we were after in the field of equipment design criteria was some future thinking on the state of the art. An example of this is the thinking on frequency stability, which becomes a very important factor in the selection of such things as the type of modulation and the bandwidth requirements or receivers. A transmitter output power spectrum was promoted which would be essentially a mirror image of the receiver characteristics. Also, receivers were assumed whose image response, spurious responses, and desensitization were many orders of magnitude better than the present state of the art. This would mean that transmitter filters, preferably integral with the output tube, would be required. Present design of receivers with r.f. bandwidths far in excess of the i.f. bandwidth could be greatly reduced by r.f. filtering or a selectivity which closely matched that of the i.f. response.

Narrow band modulation schemes received considerable attention in the tactical studies since they provide better receiver sensitivity, which permits a type of tactical equipment having lower transmitter radiated power. Associated with such studies are the forms in which intelligence should be presented, e.g., voice, teletype, facsimile, etc. Also important were methods attendant to a further reduction in the intelligence bandwidth associated with these types of intelligence presentations. The desired degree of security which should be provided in all systems at each level in the field army command was also considered. Improved crystal tolerance and frequency stability of the future will make the narrow band modulation schemes assume greater importance. This is so because the total bandwidth requirement will be decided by the bandwidth of the type of modulation being used instead of that required for frequency stability and crystal tolerance.

Thus, in general, we can say single side band rates high in spectrum economy; frequency modulation rates favorably in freedom from noise, re-use of channels, and use in motion; while pulse code modulation rates in re-use of channels freedom from noise, and repeater use.

The interference criteria to be used in conjunction with the mutual interference studies received considerable attention. Data on this subject are limited and such data as are available are useful only insofar as they provide laboratory type information, namely, the steady state condition. Nature very rarely lets the steady state exist and if she does, it is only for a limited time. All received electromagnetic transmissions between two fixed stations vary in field strength with time. If one or both terminals of a transmission circuit are vehicular, the variations are even more marked. In general, if one talks about the median received signal, both wanted and unwanted, there is associated around the median a fluctuation or distribution which is uncorrelated. Thus, if both wanted and

making full use of good equipment design criteria, optimum methods of spectrum allocation, and using realistic techniques of frequency assignments. — General Cook

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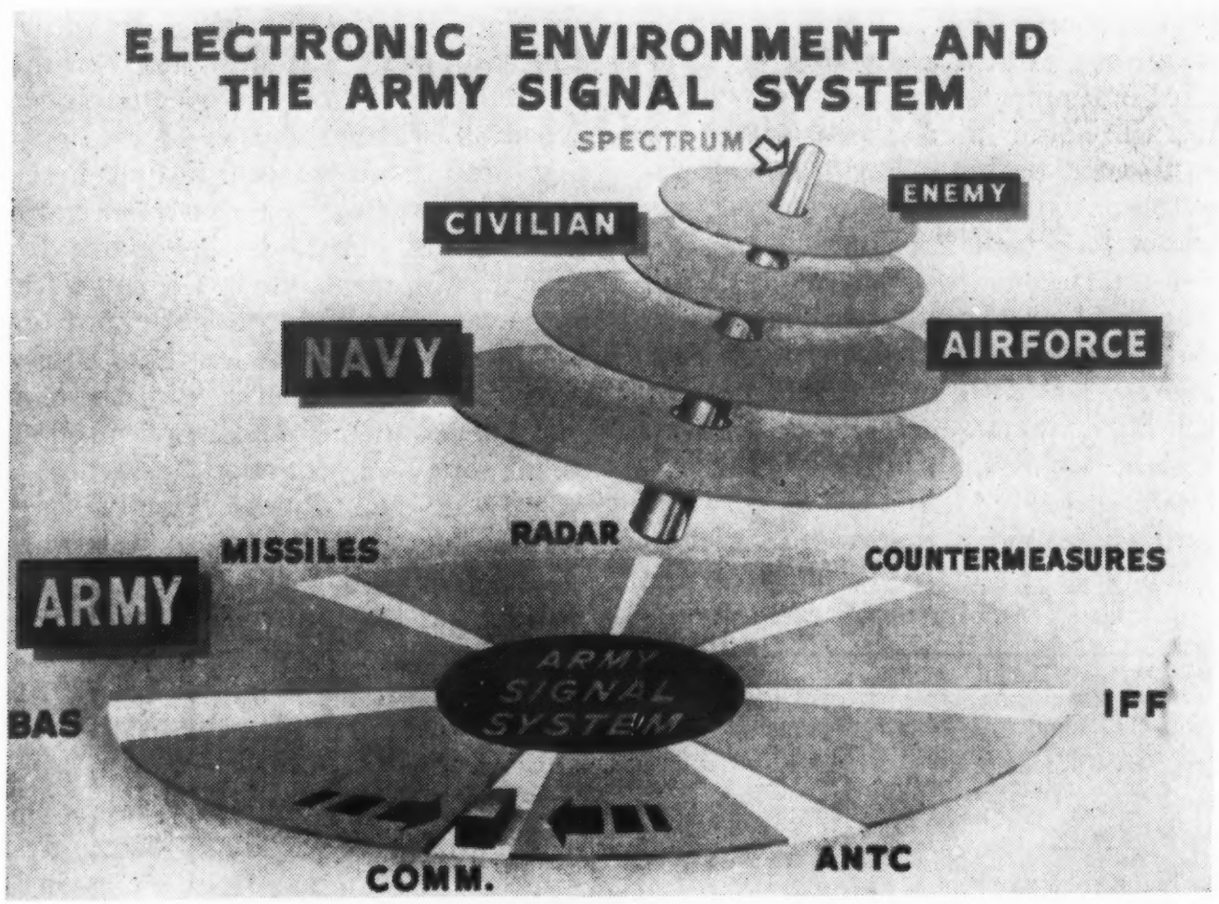

Figure 1

unwanted signals had the same median value of received field strength, then when the unwanted fluctuated higher than the median, the wanted would be correspondingly lower than the median.

The type of modulation whether SSB, AM, FM, or pulse, wanted or unwanted, greatly influences the interference criteria to be used in interference studies. For example, the capture effect of FM is well known and therefore, a small over-riding unwanted signal at the front end of the receiver appears greatly enhanced at the output of the receiver.

Some tests were conducted of off-channel and far off-channel interference. Communications systems were located near radar systems and the interference effects with distance were noted, analyzed and made use of in the studies.

After the study of operational requirements and the various systems studies had been completed, the systems group was able to consider the spectrum allocation problems.

The useful frequency spectrum generally associated with radio waves, has been pushed higher in frequency with the advent of new tubes and equipments capable of exploring the complicated laws of wave propagation. Unfortunately, in the past, the need for a particular type of service precluded the full exploration of the wave propagation phenomenon associated with the higher frequency range. Allocation tables which are proposed at international conferences or at joint services boards are more of an expression of the need for spectrum space by a particular type of service than a choice based on firm technical considerations. This is true since at the time of preparation of these allocation tables a full understanding of the laws of nature as they affect wave propagation and systems was not available and is only now partially understood.

The equipment limitations imposed by tactical doctrine of our field army of the future legislate a frequency spectrum that is different from that prescribed for zone of interior, continental defense, or for that matter, commercial service. There is no reason to assume, for example, that because a commercial fixed-to-vehicular service is in a certain frequency band that the field army mobile-to-vehicular service should be in the same band. The constraints such as heights of antenna and transmitter power output, for example, are certainly vastly different for the two Services. The equipment constraints imposed by World War II field army tactics are certainly much different than those of future field armies. The frequency spectrum, then, has to be designed for the particular brand of service required by the tactical doctrine of our field army. This in turn dictates the constraints which will be imposed upon the electronic systems and equipments. In other words, changes in tactical doctrine of our field army, new systems and a more thorough understanding of wave propagation, will require a review and possibly a change in systems and equipment needs which in turn will require a frequency spectrum utilization review. Such a review can be made periodically or when important findings which effect frequency spectrum engineering take place.

Spectrum allocation of the various systems was made using a dynamic approach, i.e., fitting the allocation to the tactical operational requirements. It is at this point that the proposed systems to satisfy the tactical requirements and the system engineering criteria come into sharp focus. The full picture of the technical factors, tactical factors, and constraints imposed on the systems have been determined and it will be found that if the system is at all feasible, a highest frequency, an optimum frequency, and a lowest frequency allocation can be determined. This spectrum allocation comes about from the fact that when one imposes constraints on a system, the parameters of that system change. For example, antenna gain increases with frequency for a fixed size of an-

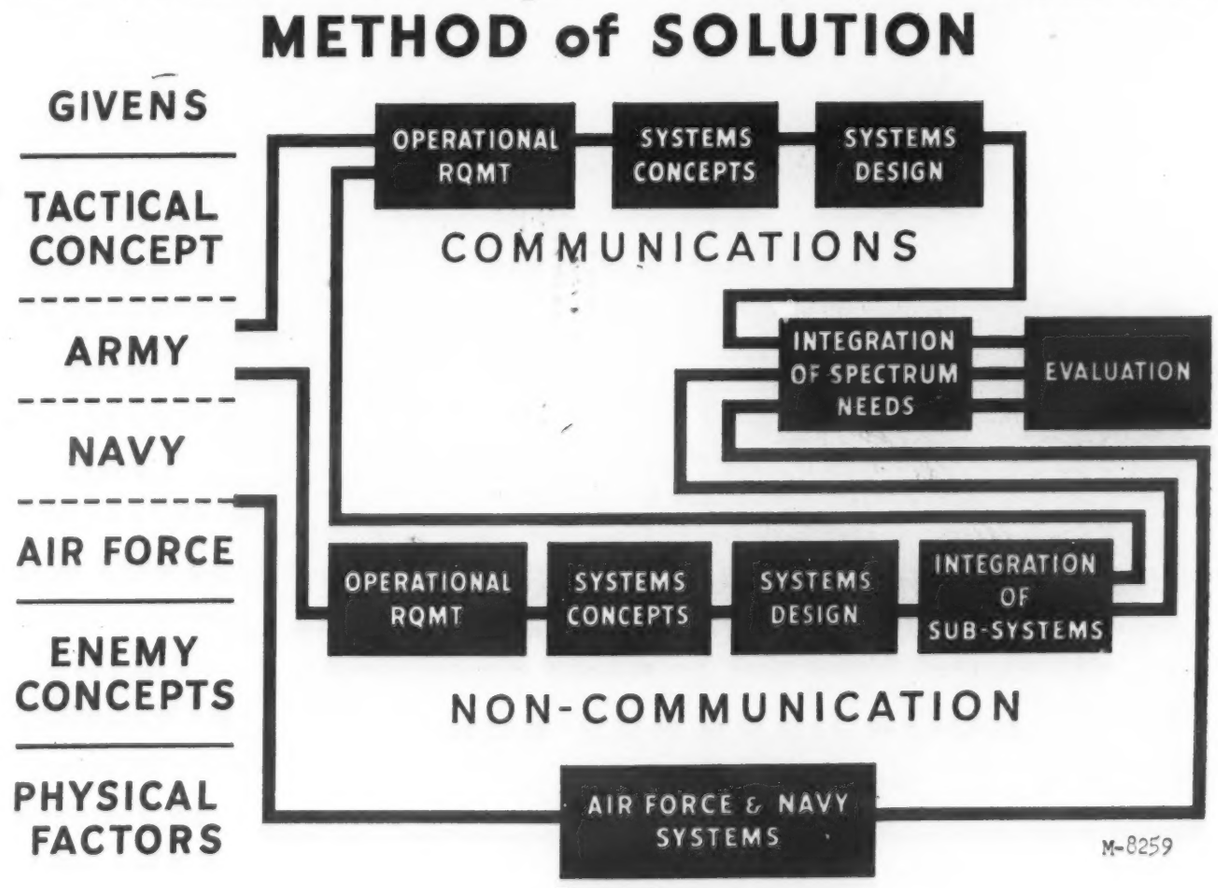

Figure 2

tenna; path attenuation over irregular terrain increases with frequency; man-made or indigenous noise decreases with frequency; the noise figure of a receiver increases with frequency, etc. The variations with frequency are not all linear or in the same direction and, after combining these relationships, the resultant will have a maximum, optimum, and minimum frequency allocation. All of this is dependent on the constraints not being too severe.

Techniques of frequency assignment in the future field army were devised in order to arrive at the number of r.f. channels which would be required to permit freedom of movement, say within a division area, of like equipments without inter and intra division interference. Based on equipment design criteria and propagation, frequency assignment to permit adjacent channel operation without interference was also considered. The total number of r.f. channels to do the required job in a future field army area with no interference or tolerable interference was arrived at, which, when multiplied by the r.f. channel spacing based on design limitations, provided the amount of frequency spectrum required to do the job. This is in sharp contrast to some previous practices of design in which the equipment was designed to tune over the entire band allocated for a function, without density studies having been made to see if that much spectrum was really required or available. Thus, one finds that many different equipments cover the same frequency spectrum or a large portion of the same band. When these equipments are made operational, the Signal Officer in the field is required to come up with frequency assignment plans and techniques which will result in no interference or tolerance interference. Also, the attendant wide tuning range results in receiver performance figures which are much poorer than they might be if the range were limited only to that required.

In this study, tuning of radars became a necessity. Radars for the first time were assigned frequencies in a manner similar to communication practices. Thus, the amount of frequency spectrum to fulfill a systems requirement was positioned in its spectrum allocation along with other spectrum needs. Fortunately, on the basis of design criteria well beyond the state-of-the-art, the total spectrum requirements did not exceed the available or useful portion of the electromagnetic spectrum as far as the field army of the future is concerned. Also, the spectrum requirements of each system did not exceed its spectrum allocation. As a matter of fact, it was possible to provide guard bands between systems.

It should be remembered that this entire study was one of mutual interference and therefore in no way indicates the amount of additional spectrum or even changes in systems philosophies that may result from electronic countermeasures, enemy mutual interference, enemy countermeasures or counter-countermeasures—all of which are the subject of the continuing Project MONMOUTH effort.

While Air Force and Navy Electromagnetic requirements were considered in these studies, much closer coordination along the lines of fully integrated electronic systems requirements mentioned in "What Price Frequencies?" must be accomplished in order to realize the maximum in spectrum economy.

The signal complex for the future field army will not suffer intolerable *mutual* interference if thorough systems planning and engineering is conducted by making full use of good equipment design criteria, optimizing methods of spectrum allocation and using realistic techniques of frequency assignment.

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MANY FLIGHTS BETWEEN AIR TERMINAL points are made daily by military, commercial and civilian aircraft. Fundamental traffic data on the actual number of aircraft, in a given terminal area (under conditions of instrument flight regulations [IFR]) have been the subject of many studies. Data on actual air traffic control demands, based on studies of air traffic under visual flight regulations (VFR), are not thoroughly reliable. Therefore, it is believed that the increasing complexity of air traffic throughout the continental United States requires positive air traffic control to avoid mid-air collisions under both VFR and IFR conditions.

There are many agencies throughout the United States employing search-type radars which can be utilized to obtain the air traffic control required to save lives and dollars. Chief among these agencies are Army antiaircraft defense units with their radars now oriented only toward killing an enemy. The search-type radars of these units are not integral parts of antiaircraft weapons systems, but are essential for full utilization of these systems. Without the data from properly located operational extended range radar coverage radars, the tactical range capability of antiaircraft weapons systems would seriously decrease in proportion to the decrease in the approach altitude of aircraft. For example, if the approach altitude of an aircraft would decrease from 5000 to 1000 feet, radar coverage in range for any radar would decrease from 88 to 40 miles.

It is believed that air traffic growth since 1950 has increased at an average rate of about 10 percent per year —with commercial, military and private air traffic increasing proportionally. Applying this growth factor, one can readily visualize approximately 300 aircraft operating during one time period, within 150 miles of a large city like New York. The speed capabilities of such aircraft magnify the mid-air collision danger.

Air Traffic Control

This article will point out the following: some of the fundamental problems involved in obtaining effective radar coverage; some radar facilities now available to resolve the air traffic problem, and the agency having the most utilization potential in resolving the air traffic problem—provided that such agencies are properly located. It is visualized that a national agency, whose sole responsibility is for air traffic control in the continental United States, will be established to collect and collate air traffic data furnished by various radar installations. It is further visualized that reporting radar installations will be connected to the central collecting agency by direct communications, and that air-ground-control communications are available to the central agency. Subordinate control agencies are to be located at major air terminal points.

Though it is appreciated that there are many other ways to approach the air traffic control problem, radar is presently considered the most efficient, and therefore, will be the subject of this article.

The present state of the radar art has certain inherent limitations which seriously affect efficient air traffic control. In order to fully understand these limitations, two of the most important have been selected to be discussed in their technical aspects. The first limitation causes faulty radar wave propagation which results in faulty radar data, and in some cases no data at all. The second is radar line of sight as limited by the curvature of the earth. These limitations can be understood best by comparing the propagation of radar waves to those of light:

(1) Light waves are refracted, or bent, when they pass from one medium to another having a different density. This fact accounts for the phenomenon known to desert travelers as a mirage. Thus, an oasis that is actually many miles away appears to be clearly above the horizon. What has happened it that light rays from the distant oasis have been bent around the earth's curvature. This effect may result when the atmosphere is not uniform and is subject to varying composition and density, causing the light rays to travel in a curved path instead of a straight line. Similarly, radar waves can behave in a like fashion. Both the optical and radar mirage are caused by the bending of waves away from a medium of low density into a medium of higher density. The degree of bending is expressed by the changes in *refractive index*. The atmosphere may provide a curved path by which radar waves may be bent around the earth's curvature; such a curved path for radar waves is called a *duct*. Atmospheric conditions of abnormal variation affect the operation of radar equipment on frequencies generally greater than 30 megacycles. In general, the higher the frequency the greater will be the possibilities of a duct causing erratic radar wave propagation effects. The question arises—what are the weather conditions that cause the creation of a duct and the resulting propagation peculiarities. It is well known that the earth's atmosphere is subject to many variations. In general, both the temperature and the moisture content decrease gradually and almost uniformly, with height above the surface of the earth. This is the standard condition, and

when this condition occurs no ducts are formed and radar transmission is normal. However, normal atmospheric conditions may not be present at all times. In some cases, the temperature first may increase with

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path followed by a radar wave, under standard atmospheric conditions, is called the radar line of sight between two points. For most purposes, optical lines of sight may be considered as straight lines. Radar lines of sight,

height and then begin to decrease. This is referred to as *temperature inversion.*

(2) The path followed by a light wave in traveling from one point to another is called the optical line of sight between the two points. The

except when they are vertical, curve downward as pointed out above. Therefore, under normal conditions, the volume of space which one radar can cover depends on the altitude of the points in space or aircraft to be covered above the curvature of the earth, plus physical obstructions. For example, assume that the average radius of the city of Philadelphia was 20 miles with no physical radar line of sight obstructions. It would require a minimum of six (search-type) radars, equally and properly spaced around the city, to provide a volume of radar coverage. This would cover 80 miles around the city for 1000-foot altitude points in space or aircraft above the earth's curvature. It should be noted that aircraft at speeds of 600 miles per hour would cover this straight line distance in 8 minutes. Eight minutes of air traffic control is not enough. Therefore, many search-type radars are required to resolve the critical air traffic problem in and around the cities of the continental United States.

Agencies which operate radars constantly throughout the United States are the Army, Navy, Air Force, Civil Aeronautics Administration (CAA) and certain radar development and production agencies. It is believed that this available source of radar equipment is adequate to resolve the air traffic problem, if properly organized and located on a national basis. It is assumed Air Force radars provide long range coverage for the air defense of the continental United States; Army radars, excluding radars that are integral parts of antiaircraft weapons systems, provide operational radar coverage which insures full utilization of antiaircraft weapons systems. Naval radars augment Air Force radars and provide radar coverage for Naval ships and installations, and finally, CAA radars are used in consonance with civil air traffic. These are adequate radar facilities to provide efficient air traffic control throughout the continental United States, provided they are properly located.

It can be reasonably assumed that the terminal points for the major portion of all United States air traffic coincides with a majority of the cities which Army antiaircraft units are defending. It is further assumed that the complete and continuous radar coverage required for full utilization of antiaircraft weapons systems is more than adequate for air traffic control when properly located throughout the range of these operational radar coverage radars surrounding these cities.

In order to best understand the radar coverage problem, one must assume that there is no radar line of sight obstruction above the earth's surface, and that each radar line of sight to points in space is limited by the curvature of the earth only. For example, take a piece of ordinary paper and place a pencil point in the center to represent a radar location. Then draw north-south and east-west lines through this point extending two inches in each direction. Center a dime over this point, inscribe its perimeter, and let the diameter of the dime represent 40 miles, the approximate diameter of a large city. It should be noted that the location of this radar in the center of the city would provide radar coverage only out to 20 miles beyond the perimeter of the city for points in space or aircraft at 1000-foot altitude due to the curvature of the earth only. Now place a point on the perimeter at each line intersection and inscribe perimeters for each point whose radii are equal to the diameter of the dime. These four circles indicate the radar coverage of points in space or aircraft at 1000-foot altitude for four radars located around the perimeter of the city. It should be noted that now the radar coverage has been extended to a maximum of 40 miles beyond the perimeter of the city at four points by utilizing four radars instead of one. Indefinite radar coverage in range, for 1000-foot altitude points in space or aircraft approach, can be attained by increasing both the number of radars and their emplacement distances from the center of the city.

Conclusion

Finally, because of the precise, complete and continuous radar coverage required for full utilization of antiaircraft weapons systems, the presence of these operational radars, properly sited around air traffic terminal points, presents the greatest potential source for air traffic control around such cities. The other sources of radar coverage mentioned above neither possess, nor require, the precise, complete and continuous radar coverage capability that is required by antiaircraft weapons systems. Accordingly, individual antiaircraft defenses are capable of providing efficient air traffic information to a central collection and control agency without interference with the antiaircraft mission, and accentuating the much overlooked need for locating antiaircraft operational coverage radars at optimum locations.

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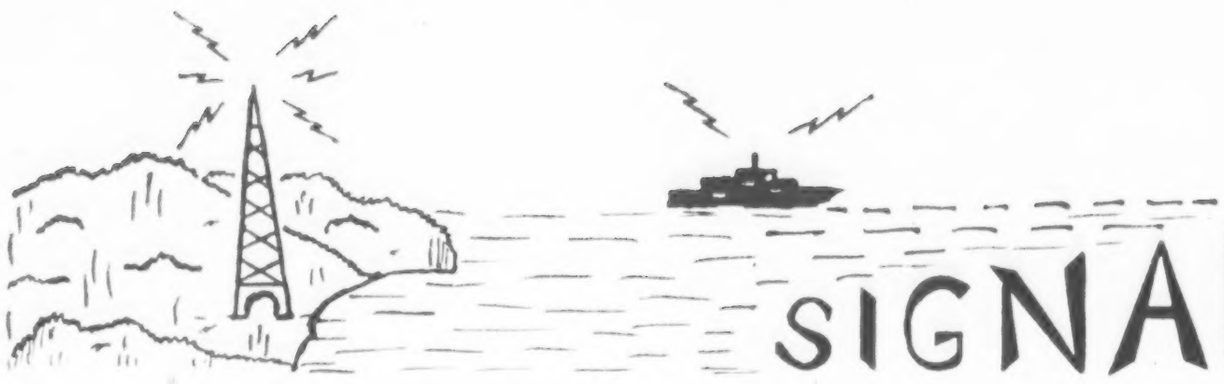


SIGNAL·GRAM

— GOVERNMENT —

PLANS FOR MISSILE SQUADRON The Air Force will form its first intercontinental missile squadron this year, but no missiles will be launched from operational sites "except in case of war," the announcement said. The unit will be ready to operate Snark weapons by the end of 1957. The squadron, assigned to the Strategic Air Command, will be based at a site to be announced later.

ENTERTAINMENT FOR ARMED FORCES The Armed Forces television is adding a five-transmitter network to furnish entertainment to U.S. troops of all services in South Korea and the surrounding area. With this addition, 17 remote sites will now have access to military television. The Armed Forces Radio-TV Service occasionally adds new radio outlets, and an up-to-date count shows 39 standard broadcast and 36 closed circuit stations, world-wide.

FCC AND PAY TV The FCC's ruling in September on experimentation with subscription television will be brought to the attention of Congress when it convenes in January. Meanwhile, the FCC has presented rulings providing for acceptance and consideration of applications for authority to conduct nationwide tests for a period of three years. Under the ruling, each pay-TV method meeting FCC requirements may be tested in a maximum of three cities which receive a minimum of four grade A commercial signals. Applications may be filed now, but will not be acted upon before March 1, 1958. The lengthy delay will give Congress an opportunity to study and evaluate this controversial matter.

MORE BUSINESS FOR SMALL BUSINESS Government contracts set aside for exclusive award to small business for Fiscal Year 1957 amounted to $744,335,298, almost 50% more than the 1956 figure of $497,678,432. The percentage of military prime contract procurement awarded to small business suppliers and nonprofit concerns was increased from 16.3% in the first half of Fiscal Year 1957 to 23.2% in the second half. This increase is attributable in part to the efforts of the Defense Department to offer small business greater opportunities to compete for military prime contracts, along with the Small Business Set-Aside Program conducted jointly by the Department of Defense and the Small Business Administration.

CONTRACTS: ARMY: W. L. Maxson Corp., production of missile components, $2,050,000; International Resistance Co., research and development in resistor design, $195,097; Gilfillan Brothers, Inc., target drone instruction and maintenance, $404,745; Stromberg-Carlson Co., manual telephone switchboards, $2,226,000. NAVY: Sperry Gyroscope Co., TALOS missile guidance systems, $47,000,000; Canoga Corp., four radar systems, $1,087,458; Hazeltine Corp., coder-decoder, $1,180,283; Burner-Hollomon Mfg. Corp., TERRIER missile handling equipment, $217,192; Admiral Corp., electronics equipment, $1,196,000. AIR FORCE: General Electric Co., over-the-horizon scatter communications equipment, $5,135,266; Federal Electric Corp., maintenance and operation of the "White Alice" communications system in Alaska, $2,630,000 and $15,022,365 (definitive); General Precision Laboratory, radar sets, spares, data, engineering services and reports, $1,600,000; Republic Aviation Corp., wind tunnel facility to test future missiles, rockets and manned aircraft, $1,200,000; Bendix Aviation Corp., components for compass system, spare parts and ground support equipment, $1,532,639.

— INDUSTRY —

U.S.-EUROPEAN TRANSATLANTIC TELEPHONE CABLE The American Telephone and Telegraph Company has launched a new enterprise with the signing of contracts with German and French agencies for construction of an undersea telephone cable system between this continent and Europe. The $40,000,000 cable system will consist of twin cables that will cross the Atlantic between Newfoundland and the Brittany peninsular in France. It will provide 36 voice circuits; 13 will terminate in France, 13 in Germany and the remaining 10 are reserved for other countries in Europe. Both cables are scheduled for service in late 1959. (Continued on page 31)

90-FOOT PERISCOPE What is believed to be the world's longest periscope has been constructed by General Electric Company engineers and installed at the Atomic Energy Commisssion's National Reactor Testing Station. The 90-foot aluminum tube with an intricate mirror and lens system permits atomic workers to observe a "hot" nuclear reactor while in a shielded cubicle during development work on a nuclear propulsion system for aircraft.

"BLACK" SCREEN CATHODE TUBE A special black background screen for radar and other visual indicators, which eliminates limitations of such equipment under high surrounding light level conditions, has been developed by Allen B. Du Mont Laboratories, Inc. This is the first successful application of a black background directly to a phosphor film. The new screening technique allows electronic picture viewing under exceeding high ambient light conditions and is foreseen as having revolutionary future implications for television viewing.

MARKING ELECTRON TUBES A truly permanent-marking ink has been developed by Raytheon engineers and is in daily use in the production of important military miniature and subminiature types of electron tubes. This marking withstands all attempts to remove or destroy it short of actually grinding away the glass on which it appears.

ELECTRONIC TYPEWRITER PREDICTED TO TAKE DIRECT DICTATION Brig. General David Sarnoff, chairman of the Board of Radio Corporation of America, recently addressed the annual conference of the Life Office Management Association, an insurance group. He told them, "The business man of the future may well dictate his inter-office memos and personal letters to an electronic typewriter that will produce them phonetically in response to his voice."

— GENERAL —

TESTING H-BOMBS ON THE MOON A University of Maryland scientist recently proposed the moon as a safe, remote site for testing hydrogen bombs. Dr. S. Fred Singer said it would be no greater technical problem to send an interplanetary ballistic missile 240,000 miles to the moon than to launch an intercontinental missile 5,000 miles. Dr. Singer presented his views in a paper prepared for the Congress of the International Astronautical Federation in Barcelona, Spain.

RUSSIAN SOLAR POWER Radio Moscow reported Russia has begun construction of the world's first full-scale solar power station in Armenia. The broadcast said 1,300 mirrors will reflect the sun's rays and bring water in a cauldron to boiling point, with the steam operating a turbine.

UNITED ENGINEERING CENTER The new United Engineering Center is to be erected between 47th and 38th Streets on United Nations Plaza, New York. Colonel C. E. Davies, building co-ordinator for the new Center, sailed in August for Europe where he will invite representatives of 13 Western European engineering societies to share facilities in the new Center.

"STRANGE CASE OF THE COSMIC RAYS" This was the title of the third program in the Bell System Science Series recently presented on television. This scientific detective story told about the chain of investigations that led to the identification of one of Nature's most baffling phenomena—cosmic rays. Film available from Bell.

ANNUAL SINGLE SIDEBAND DINNER This event will be held during the IRE Convention March 25, 1958, at the Hotel New Yorker. Tickets are $7.50 each and can be obtained by writing The Single Sideband Amateur Radio Assn., Inc.—261 Madison Ave.—N.Y. 16, N.Y. For any further information write Edwin Piller, Chairman, Publicity Committee, at the same address.

NATIONAL CONVENTION CALENDAR

NOVEMBER 18-21 The National Defense Transportation Association will meet at the Shoreham Hotel, Washington, D. C. The latest civilian concepts of "The Shape of Things to Come in Transportation and Logistics" will be presented by outstanding leaders in the transportation world.

DECEMBER 4-5 The Institute of Radio Engineers' Professional Group on Vehicular Communications will meet at the Hotel Statler in Washington, D. C. The conference theme is: "Meeting the Demands for Vehicular Communications?"

DECEMBER 9-13 "Computers with Deadlines to Meet" is the theme of the Eastern Joint Computer Conference and Exhibit to be held at the Sheraton Park Hotel, Washington, D. C. Sponsoring societies are the IRE, AIEE, and ACM. Non-members are cordially invited and may obtain further information by writing to: Mr. Richard T. Burroughs —Registration Chairman, 1957 E.J.C.C.—I.B.M. Corporation—1220 Nineteenth Street, N.W.—Washington, D. C.

EDITORIAL

Coordination: Research & Development

A quarter of a century ago, American industry was spending $200 million a year on industrial research and development. Most of the results derived from this investment accrued to benefit business. Today, we have built up in America a powerful industrial capacity which receives its strength from research and development and technological know-how. Precisely, the progressive advancement in this field since the 1930's has contributed to our national and individual status. Research and development have grown tremendously to a point where we are spending in excess of $4 billion annually. No longer is it supported by individual industrial concerns alone. Rather, it has become an integral part of our national industrial might and extends throughout the length and breadth of our industrial effort to meet the present day challenges in both peace and war. Dynamic business initiative, labor and management leadership, and aggressive research and development have brought about a terrific change in our capacity to produce hard and soft goods and have prodigiously affected our standard of living.

Through research and development and technological know-how, management has the responsibility to provide the kind of products which best satisfy the present and future desires of Government and the people. Be this as it may, it is essentially important that careful consideration be given also to the question of critical raw materials, low cost, marketing, business expansion and the effects of increased production on our national economy. It would appear, then, that the real key to future successful industrial research requires an understanding of the problems of the people who use the final products.

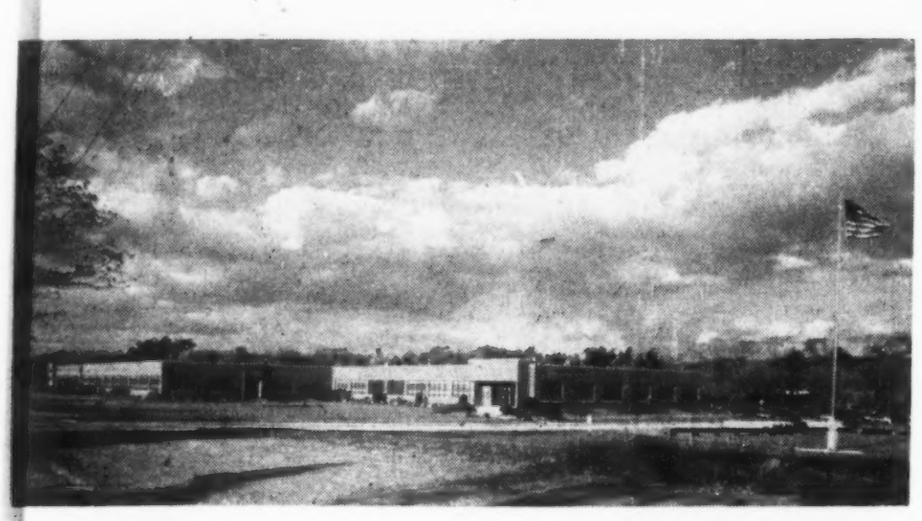
We must not lose sight of the fact that those of us who are particularly interested in this blossoming electronics age occupy a first row orchestra seat in this $4 billion research and development business. To us is given the opportunity to plan wisely for tomorrow's prosperity in this vital segment of our industrial complex.

In planning for this new era, we must pause long enough to look back, evaluate and remember the growing pains as well as the accomplishment of the communications and electronics industries during the past few years. So far, the contributions of communications and electronics to our economic way of life have been nothing short of miraculous. This is just a beginning for, from here on out, these industries are destined to play a greater role in the scheme of things. We cannot afford to be complacent or bask in the sunshine of past glories. Through an interchange of knowledge and close coordination of ideas at our chapter meetings, and by expanding our membership so that every one of us in the communications, electronics and photography fields can benefit from the experience of others, we can contribute our share to the production of soft and hard goods to insure economic stability and a maximum degree of flexibility. In this way, we can add to the conservation of our natural resources, insure our industrial technology, strengthen our research and development and preserve our national security.

The Editor

the **BOMAC** *story*

by
Richard J. Broderick
Treasurer
Bomac Laboratories, Inc.



ABOVE: Part of the spacious and spotless area devoted by Bomac to assembly of delicate electronic components.

LEFT: A pleasant setting for the production of microwave tubes, this modern plant houses 110,000 square feet of manufacturing space.

JUST TEN SHORT YEARS AGO, Bomac Laboratories, Inc., was two men—and its "laboratory" a small loft over a soft drink plant in Beverly, Massachusetts.

Today, Bomac employs over 700 people. Its beautiful, modern plant, nestled amid 35 meticulously landscaped acres adjacent to heavily traveled Route 128 in North Beverly, houses some 110,000 square feet of manufacturing space. In this pleasant setting, Bomac manufactures enough microwave tubes and components each year to gross more than $5,000,000.

For tomorrow, things look even brighter. Bomac has recently completed a new $1,000,000 plant which calls for an additional 200-400 employees.

In part, the Bomac story is a reflection of a bigger success story—the mushroom growth of the entire electronics industry in the years after World War II. But it is more, for it points up the fact that strange and wonderful things can still happen in this country when two men and an idea come together at the right time.

This is another in the series of company articles in SIGNAL, describing the growth of the electronics industry.

The two men were physicist Henry J. McCarthy, now Bomac's President, and production specialist Harold C. Booth, now Executive Vice President of the organization. In 1947, both were with Sylvania's Electronics Division—McCarthy as manager of engineering, and Booth as superintendent of the same division. Both men had a thorough grounding in electronics, and both had come up through the ranks. Their idea was simple and solid: to get into the growing electronics industry on the ground floor and serve it as specialists in the research, development and production of microwave tubes.

Utilizing Manpower

It was a good time for a move—the industry was ripe for growth in the immediate post-war years. At the close of World War II, it was concentrated in a few large eastern companies, whose principal job was to produce the component models developed at Government supported research laboratories like M.I.T. and Columbia. When these companies turned back to their respective commercial fields at war's end, the industry was left with a large manpower pool of highly trained technicians who had no intentions of abandoning their newly developed skills. As a result, new companies began to spring up—companies whose size and ability to specialize gave them inherent competitive advantages in production quantities, quality, and price. The industry was off and running.

Skill and Specialization

Booth and McCarthy added a half-dozen skilled employees and turned their attention to microwave TR and ATR tubes. It was a job that called for skill and specialization plus, for these are delicate tubes for a delicate job. They are primarily used as switching tubes for radar which performs the function of protecting sensitive receivers from the high power pulses of outgoing transmission signals. In a matter of millionths of a second, they must switch all the power of the outgoing signal to the an-

(*Continued on page* 35)

tenna, pass along the relatively low power of incoming signals, and be instantly ready to protect against the next high power pulse.

Expansion

Bomac was able to solve its ticklish production problems so well that by 1950 it had outgrown its first location and moved to its present North Beverly site. To the new plant came the eight original members of the team, plus a collection of some of the brightest engineering names in the country—microwave specialists who had left responsible positions with established electronic firms to stake their future on Bomac. Today, they form the nucleus which has kept Bomac among the industry's leaders ever since.

The infusion of new skills and a new plant in which to put them to work meant new directions for Bomac. From a handful of TR and ATR tubes, production grew to include shutters, reference cavities, thyratrons, diodes, magnetrons, klystrons, duplexers and many other types of microwave tubes and components.

In all, Bomac produces some 750 different tubes of varying types—a manufacturing problem of major proportions. For, even with the automatic glass working machines, controlled electroplating equipment, vacuum and hydrogen furnaces and all the other advanced equipment available at Bomac, the making of a tube remains a highly intricate business. Glass blowing, glass sealing processes, delicate precision soldering—these are just some of the operations that call for labor skilled to the point of craftsmanship.

Final Testing

Even when all these problems are solved—and Bomac has managed to solve them—there remains the problem of testing. Bomac can point with special pride to the most painstaking and thorough testing methods in the microwave field. Every tube is carefully tested to insure maximum uniformity and peak performance before it leaves the plant in a series of time-consuming, delicate operations.

Bomac today is in a position to satisfy a customer's most exacting needs—whether for a tube or component in production, a modification, or a completely new product. In addition to its complete line, it offers a complete engineering and development service.

A 1957 AFCEA Convention Presentation

Some Aspects Of Telegraphic Data Preparation and Transmission

by William B. Blanton, Director, Planning, Plant & Systems, Western Union Telegraph Co.

THE ENORMOUS GROWTH THAT IS TAKING PLACE IN THE ELECtronic generating, processing, and recording of data is making new demands on telegraphic communications. Because of the growing volume and the statistical nature of data, these demands stress economy and accuracy.

Preparation of Data for Transmission

Accuracy in the telegraph transmission of data must start with the original preparation of the data in a character-coded form for introduction into the transmission system. If this is done from the storage of a machine, suitable electronic circuitry can be provided to insure accuracy. In most cases, however, human effort is required in transcribing from the original typewritten forms and reports. It is telegraph experience that human errors involved in this original transcription far outnumber subsequent equipment and line transmission errors. Unfortunately, they are the most difficult to detect.

One technique, which holds considerable promise for practically eliminating transcription errors, is electronic character sensing. In this technique, the characters in the original copy are photoelectrically sensed and recognized, and a punched tape is prepared automatically. Excellent results have already been obtained where strict controls can be applied to the original printed copy, but considerably more work remains to be done before the flexibility, economy and reliability are obtained that are needed in general telegraph applications.

System designers are constantly trying to achieve accuracy and economy in the transcription of data into a form suitable for transmission by transferring to machines as many of the fixed and repetitive functions as are economically and technically feasible. Telegraph equipments and techniques are widely applicable in this field. In many organizations, the mechanization of office paper work is being accomplished by maintaining files of prepunched tapes containing fixed data and control code combinations. These tapes are used to prepare a printed document and a complete tape of each new transaction. It is necessary to insert by keyboard only the variable data pertaining to the particular transaction. The complete tape can be transmitted to other points in the organization for producing partial or complete tapes and printed copies. At these points, the new tapes can be used for processing the transaction further, any additional data that may be needed being added by keyboard.

Edge-punched cards which have the telegraph code punched along one edge of the card are also being used for the storage of data. The cards are more durable and are filed more easily than punched tape. At present, the cards are only punched, but plans are underway for equipments that will both punch and print the cards. Magnetic discs of the type used on dictating machines appear to have advantages where small amounts of data must be stored and selected at random for preparing documents. The discs are durable, have a fairly large storage capacity, can be filed along with the documents, and can readily be erased. Development work is now in progress on this type of equipment.

In some instances of transcribing data, the process is essentially that of entering variable data on one of a number of fixed forms. One way of merchandising this process is to provide for each type of form a removable program panel that will cause the fixed information to be entered automatically.

A prototype setup has been made, consisting of a telegraph page printer, a printer-perforator, a transmitter and a plug board apparatus, for off-line use in typing a printed form and at the same time preparing a printed perforated tape for use in further processing or transmission. The printer is provided with a carriage position register that indicates each of its 72 positions, and a line register that indicates each of 20 lines on the form. Sixteen different line programs can be set up on the plug board.

At the top of Figure 1 is shown part of the printed form, and below is shown the tape produced. The line programs will cause the character or a combination of characters shown below the tapes to be inserted automatically when the printer carriage arrives at designated positions. By means of the line position register, any line program can be made effective at any desired line on the form. Generally, several lines on a form will use the same program. Inserted characters may advance the printer carriage to the next field on the form, or may convey any kind of fixed information. If desired, characters may be punched in the tape only, for use in further processing. The operator key-strokes only the variable information, shown above the tapes, thus reducing the possibility of human error.

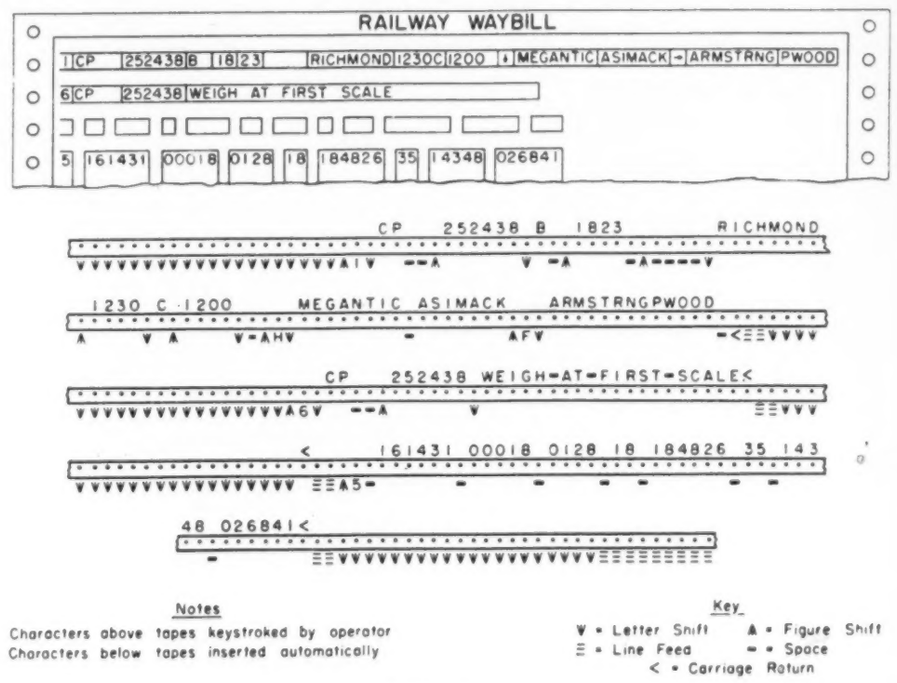


FIGURE 1

Line Facilities for Data Transmission

Before the data processing revolution, telegraph transmission was mostly of discrete messages, prepared by humans and read by humans. Telegraph transmitting and receiving equipments capable of speeds of 65, 75, or 100 words per minute with the 5-level telegraph code were economically satisfactory for that traffic. Now, with machines producing and consuming data in increasing amounts, there is a growing need for transmission facilities that are economical for the bulk transmission of data. Usually this requirement is expressed in terms of "high speed data transmission." In most cases, however, high speed is not the essential element but rather is the generally accepted means of meeting the requirements.

The 3-kc voice band is the vehicle for all of the trunk or long-haul circuits in the present Western Union plant. Each of these 3-kc bands is divided into two half-bands. Each half-band has a useful spectrum from approximately two hundred and twenty-five to sixteen hundred and twenty-five cycles and is frequency-divided into 9 telegraph channels that are suitable for speeds up to 100 words per minute.

Since the half-voice band is available throughout its plant, Western Union has turned its attention to the development of suitable terminal modulating and demodulating equipment for using

(*Continued on page* 38)

these half-bands for the high-speed transmission of data. This work is nearing completion, and tests indicate that a signaling speed of about 400 cycles per second is practicable. In computer language, this is 800 bits per second, or somewhat more than ten times the signaling speed of a 100 word-per-minute telegraph channel.

In addition, plans are underway for providing a telegraph channel of about ⅛th voice band width, which will be suitable for a signaling speed of around 100 cycles per second, or 200 bits per second. Such a channel can be used by one IBM transceiver circuit operating at the rate of 11 cards per minute, or for the transmission of seven-level paper tape at the rate of 200 words per minute.

Western Union pioneered in the development and application of frequency modulation for telegraphy. Our trunk line plant comprising several million channel miles is operated by this method. As a result, we enjoy a unique resistance to errors due to changes in the transmission characteristics of the voice band and errors due to fortuitous interference.

Regenerative repeaters are not normally required even though several sections of carrier channels are operated in tandem. Therefore, 6, 7, and 8-level or even higher level data codes can readily be transmitted over line facilities that are in general use for 5-level code transmission.

Accuracy in Data Transmission

Error detection and assuring accuracy in transmission is a problem that is not unique to long distance transmission of data. As is well known, computers and other data processing systems that transmit data within the same machine, and possibly to other machines a few feet away, are replete with error detecting arrangements. Transmission systems are subject to more extraneous interferences, but even if these were not present, it would be necessary to protect against equipment and component failures.

Many schemes have been devised for providing error detection. Almost invariably, these schemes require redundancy: that is, the transmission of more information than is necessary to convey the intelligence.

Examples of vertical checking codes in which the redundancy is individual to each character are the odd or even parity codes, and the codes having a fixed ratio of marking and spacing pulses. The parity codes may be 5, 6, 7, or 8-level codes, but in any case, each valid code combination has an odd number of marking pulses when an odd parity check is employed, or an even number of marking pulses for an even parity check.

It is almost universal practice for electronic computers that operate with both alphabetic and numeric characters to employ a 7-level code. Six of the levels define the character and the seventh is for the purpose of obtaining a parity check. Unfortunately, the assignment of characters to the code combinations varies for practically every computer manufacturer.

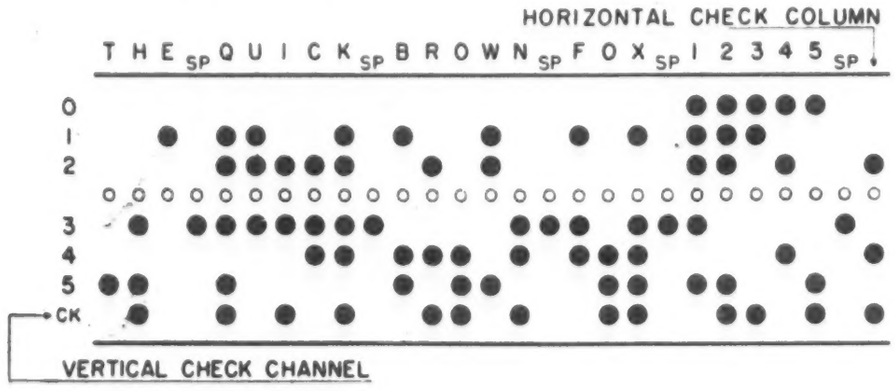
Examples of the fixed ratio codes are the familiar eight-level code where all valid code combinations have four marking pulses, the seven-level code where all valid code combinations have three marking pulses, and the five-level code where all valid code combinations have two marking pulses.

While the fixed ratio codes are more redundant than the parity codes, they are less subject to compensating errors. For example, the loss or gain of two pulses is undetected by parity codes but is caught by the fixed ratio code. Both types of codes fail to detect loss or repetition of complete characters. A common method of guarding against this is to organize the data into groups having a definite number of characters and transmit a signal after each group. Both types of code fail to detect a loss and gain of a pulse within the same character. One method of increasing the effectiveness of parity codes is shown in Figure 2. A 7-level odd vertical parity check is combined with a horizontal check. After each block of data there is inserted a character chosen so as to make each of the 7 levels have odd parity.

Transmission within a computer is usually on a parallel basis. Each level of the code is transmitted by components individual to the level. Faults are generally confined to one level. The vertical parity code is very effective for this mode of operation.

Over a communication line, code pulses are transmitted in serial form. Fortuitous faults are very apt to affect two or more adjacent pulses within a character. Some tests made over a marginal line indicated that 7-level vertical parity checking detected about 90% of the errors. A horizontal parity check applied to groups of approximately 60 characters detected approximately 99% of the errors. It is reasonable to expect that a combination of the two would have been almost 100% effective.

Clearly there are many problems to be solved before a telegraph switching system can be designed which will accommodate these various codes and checking systems and yet have the general applicability of present systems that operate on the 5-level code. Considerable thinking is being done along these lines, but probably more important, an EIA committee composed of representatives from communication companies and computer manufacturers is attempting to standardize code practices. Meanwhile, immediate demands for the transmission of the various codes and checking systems will be met by conversion units or custom tailored systems.



VERTICAL & HORIZONTAL PARITY CHECK
FIGURE 2

Multi-Station 7-Level Data Transmission with Error Detection

Modern equipment which is used at one station of a recently developed multi-station system will permit a central station and as many as eight outstations to share a one line circuit. The equipment transmits tape perforated with a 7-level, odd parity checking, data code, and checks each character for parity at the receiving station. Commercial Controls tape readers and punchers and Model 28 printers are used in the system.

To send a data message from any outstation, one inserts the 7-level tape in the reader and depresses a request button. When the circuit is idle, the station is automatically connected to the circuit and the message is transmitted into the central station. The central station can similarly send a message to any outstation by depressing the appropriate push button. When the circuit is idle, the outstation will be selected automatically and the message transmitted.

As each received character is punched in the tape, an odd parity check is made. If it does not meet the check, the transmitter is stopped, alarms are actuated at both the sending and receiving stations, and the printers are cut into the circuit. The operators use the printers to determine what action to take. Generally, the tapes are set back to the same point, and at the receiving end the errored portion of the message is "rubbed out" by overpunching. Then transmission is resumed.

5-Level Code Transmission with Error Detection

The foregoing illustrates a method of error detection employing a 7-level code. However, the public telegraph system and most private wire networks—both commercial and military—operate with the 5-level telegraph code. Since this is the common telegraph language, there are a large number of business machines and other data equipments in daily use that function with 5-level tapes. We have, therefore, devoted much of our effort to developing methods of error detection and correction in 5-level code transmission.

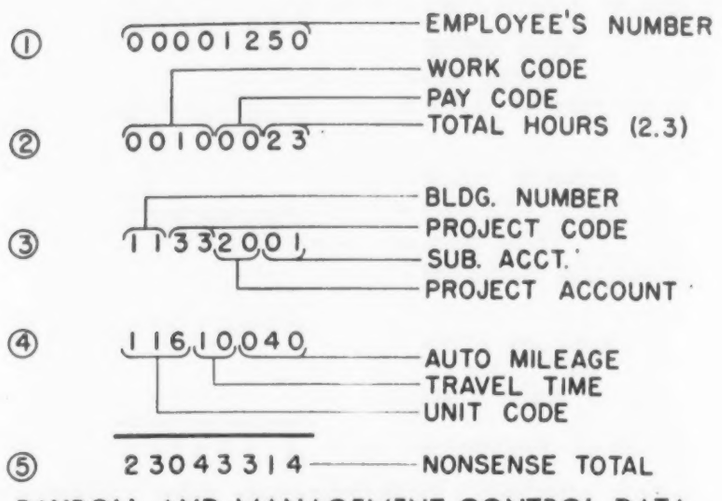
Before considering error correction, we must first develop an acceptable method of error detection for the 5-level code. As a background for the method I am going to describe, let us review a successful application of a programmed accuracy check.

When data consist of groups of figures, totaling each group and transmitting the total provides a very effective method of error detection. The receiving station performs the same addition and determines whether its total agrees with the transmitted total. This method of error detection is limited to numeric information, but it provides an effective foundation for the development of a method for checking both alphabetic and numeric characters.

Western Union is making extensive use of this type of accuracy check in transmitting its own payroll and other management control data over our Public Message System. In field offices, perforated tapes containing operating data entirely in numeric form are prepared on Friden Add-Punch machines. These adding machines prepare a printed tape and a perforated tape. Figure 3 shows the information extracted from an employee's daily work report. All of the information is entered into the add-punch machine in 4 groups of digits. A "nonsense total" is calculated and recorded automatically on the printed tape and in the perforated tape.

The tapes are then transmitted to division headquarters where they are converted to punched cards. The cards are run through computers for the automatic preparation of payrolls and management control reports. To insure accuracy, the computer also adds the numbers in each group and compares the total with the transmitted "nonsense" total. If they do not check, the card is rejected and a re-run is requested.

The "nonsense" total method of error detection has proved to be very satisfactory in practice, and we have yet to discover an error which was not detected by this check.



PAYROLL AND MANAGEMENT CONTROL DATA

FIGURE 3

Western Union is developing a system that will provide error detection and correction for data consisting of both alphabetic and numeric characters. This system employs a totaling technique somewhat similar to the "nonsense" total in that the marking pulses in a line of data are totaled on a weighted, binary basis. The system employs equipments at the sending and receiving ends of a circuit for providing error detection and correction while transmission is taking place.

The transmitting equipment can send tapes already having checking information or can automatically insert checking information after each line. In either case, the transmitter will stop after sending the checking information for each line of data to await instructions from the receiving station. The receiving equipment checks each line of data with its associated checking characters. If the check indicates no error, the transmitter is signalled to send the next line. If an error is indicated, the reperforator deletes the errored line from the tape, and signals the transmitter to repeat the line of data. This type of system has been christened EDIT. This term has a significance other than its literal meaning —it is "Error Deletion by Iterative Transmission."

Figure 4 shows the prototype EDIT reperforator, used at the receiving station. It is arranged to handle 5, 6, 7 or 8-level tapes. It has both punching pins and sensing pins. These two sets of pins are one character apart. Immediately after a character is received and punched, the tape is advanced to its next position, where that character can be read by the sensing pins. In this manner, characters are read for error checking purposes. To "rub out" a line of data having an error, the tape is back-stepped with all punching pins operating to over-punch each character. The sensing pins determine how far to back-step. The EDIT transmitter also is arranged for handling 5, 6, 7 and 8-level tapes. It can step and read the tape either forward or backward.

The reperforator and transmitter operate on a parallel input-output basis. Electronic distributors are associated with them for serial operation over a telegraph circuit. They may be operated at regular telegraph speeds of 65, 75 and 100 words per minute, or a higher speeds up to 200 words per minute.

With suitable associated circuitry, the EDIT equipments can be used for error detection and correction in the transmission of any of the 5, 6, 7 or 8-level code systems. However, this discussion will be limited to a system that has just reached the prototype stage, in which error detection is applied to the standard 5-level telegraph code.

The redundant error checking information is contained in two code combinations that are inserted after the "carriage return" that denotes an end-of-line. This signal for inserting the error checking

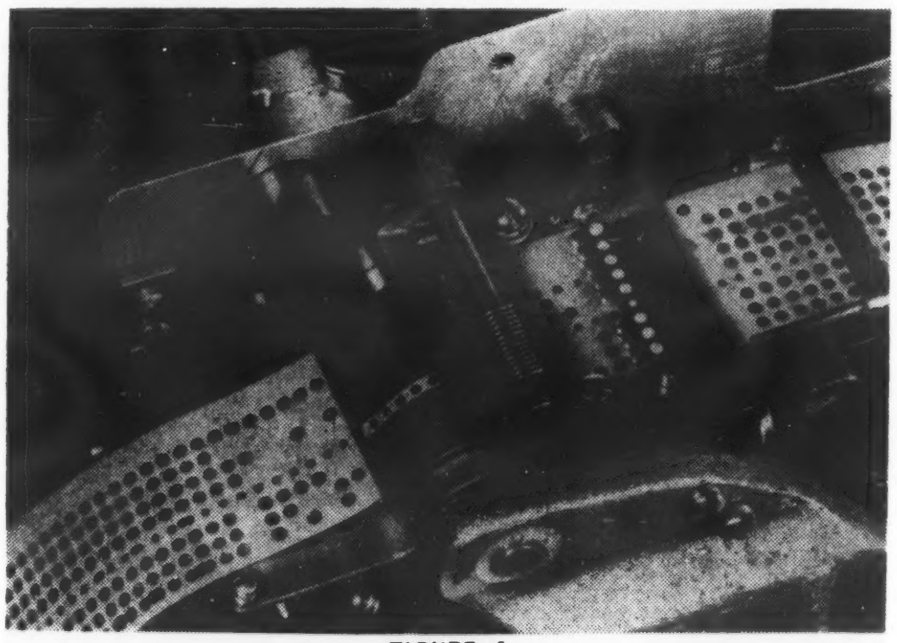
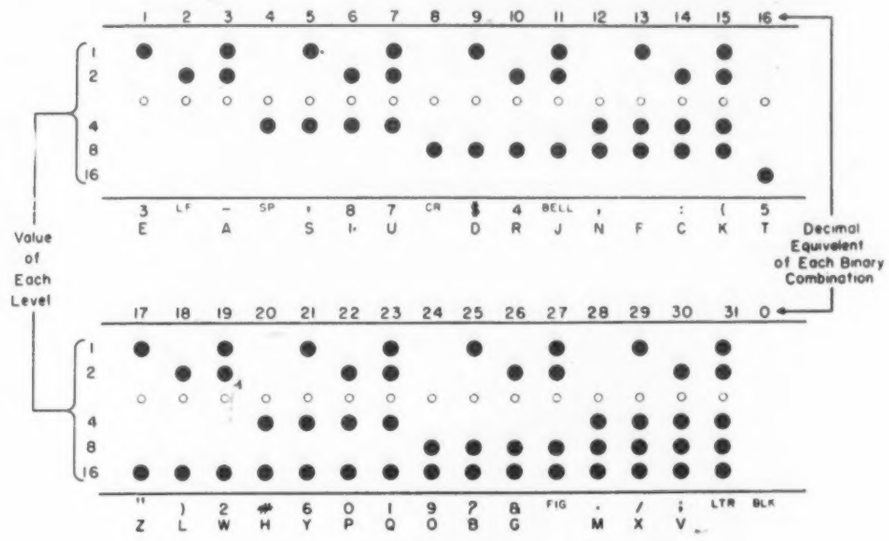


FIGURE 4

information could be two "carriage returns," or for that matter, any character or combination of characters that is not used for data characters.

The two error checking characters carry the binary total, on a modulus of 256, of all the code combinations in a line of data.

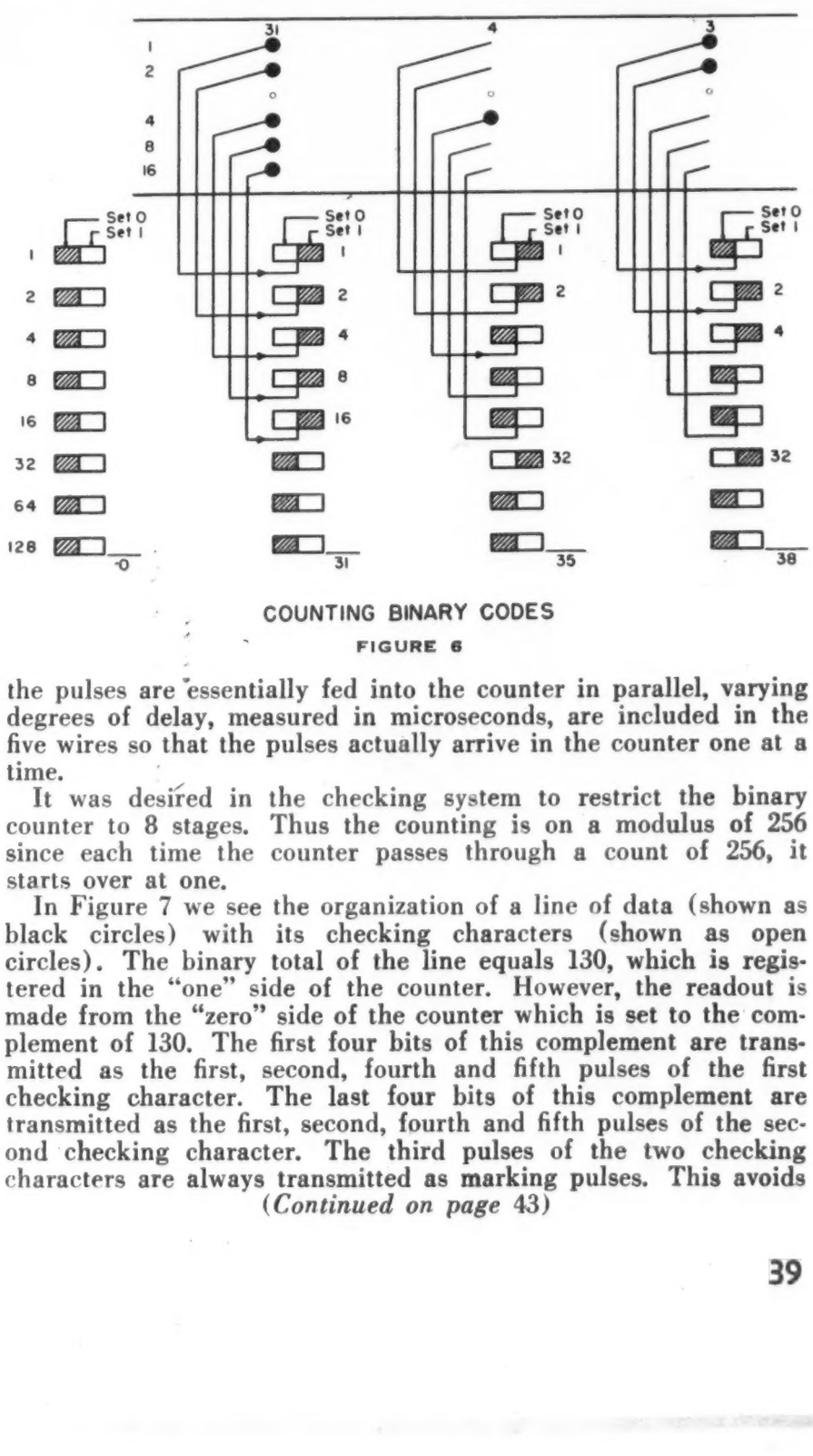
Figure 5 shows the 32 combinations of the 5-level code. At the bottom of each combination appears the character assignment generally used in telegraph service. Above each code combination is shown its binary value expressed as a decimal number.



5-LEVEL TELEGRAPH CODE

FIGURE 5

The method of accumulating the binary total of all the code combinations in a line of data is quite simple. The different valued pulses of each code combination are fed into the corresponding stages of a binary counter. As shown in Figure 6, the first character has five marking pulses which will cause the first five stages of the counter to set from zero to one, giving a total count of 31. The next character has only a third marking pulse. This resets the third stage to zero, which in turn causes the fourth and fifth stages to reset to zero. The resetting of the fifth stage to zero causes the sixth stage to be set to one, thus giving a total of 35. The next character has a first and second marking pulse. While



COUNTING BINARY CODES

FIGURE 6

the pulses are essentially fed into the counter in parallel, varying degrees of delay, measured in microseconds, are included in the five wires so that the pulses actually arrive in the counter one at a time.

It was desired in the checking system to restrict the binary counter to 8 stages. Thus the counting is on a modulus of 256 since each time the counter passes through a count of 256, it starts over at one.

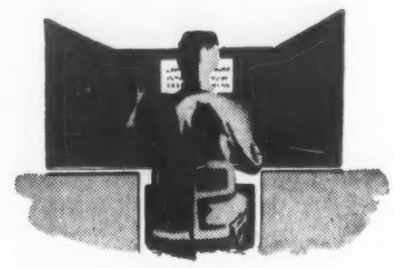
In Figure 7 we see the organization of a line of data (shown as black circles) with its checking characters (shown as open circles). The binary total of the line equals 130, which is registered in the "one" side of the counter. However, the readout is made from the "zero" side of the counter which is set to the complement of 130. The first four bits of this complement are transmitted as the first, second, fourth and fifth pulses of the first checking character. The last four bits of this complement are transmitted as the first, second, fourth and fifth pulses of the second checking character. The third pulses of the two checking characters are always transmitted as marking pulses. This avoids

(*Continued on page* 43)

R

RAPID

RACE* eliminates slow, time-consuming manual tests by electronically checking complete weapon system such as missile or aircraft. Operating on initial assumption that system is functioning properly, RACE speeds through primary test of over-all system or major sub-systems. If fault exists, RACE signals "no-go", then isolates fault through secondary tests. Complete job is done in only minutes.

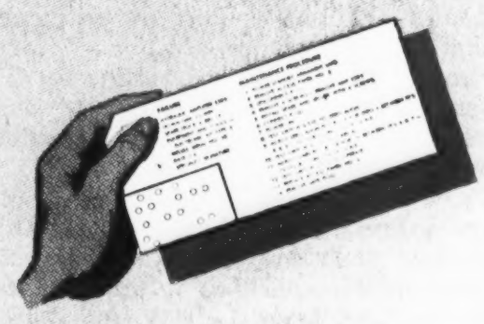


1008 HOURS

A

AUTOMATIC

Advanced design eliminates chance of human error by use of standard computer techniques of programming, memory, digital and analog comparison. Signal generators include electrical, electronic, hydraulic and pneumatic signal sources, as required to actuate circuits or simulate system signals for comparison with standard reference signals.

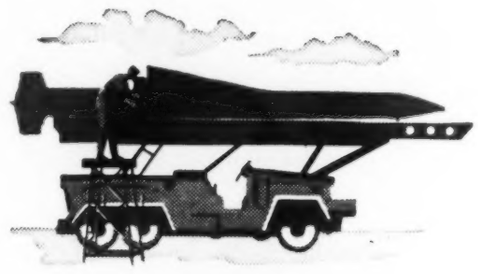


1009 HOURS

C

CHECKOUT

RACE not only pinpoints weapon defect —it also flashes on control console screen location, name of faulty unit, down-time involved, location of spare, type of technical work required, system power and arming conditions for safe repair. Simultaneously, punched maintenance card with complete, detailed instructions for repair is automatically ejected.

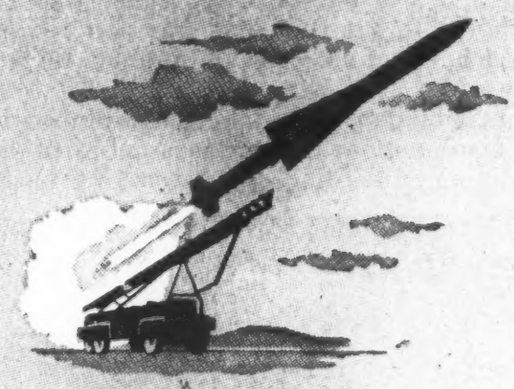


1025 HOURS

E

EQUIPMENT

Design flexibility adapts RACE for use at operational sites in pre-launch and pre-flight check-out, for in-flight testing, for maintenance areas and overhaul depots. Current and future applications include missile data reduction stations, shipborne and airborne radar, automatic navigation systems, aerial reconnaissance systems, ground fire control systems and missile guidance systems.



1030 HOURS

*T.M.

Today Sperry is working closely with all branches of the military—Army, Navy and Air Force – in applying RACE to major weapon and defense systems. For more information on RACE, write our Microwave Electronics Division.

MICROWAVE ELECTRONICS DIVISION

SPERRY GYROSCOPE COMPANY
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A 1957 AFCEA Convention Presentation

Processing, Narrow-Band Transmission And Remote Display of Radar Data

by Sheldon P. Detwiler, Supervisory Engineer, Electronics Division, Lewyt Manufacturing Corp.

IN RECENT YEARS, AS THE USE OF radar systems has become more and more extensive, requirements have developed for the remote display or use of radar data. These requirements have been satisfied by several types of remoting systems—each fitting a particular need. This article discusses, in general terms, one family of such systems and, in particular, the AN/FST-1 Coordinate Data Transmitter, nick-named SDV for Slowed Down Video, which is utilized in the SAGE system for the transmission of so-called "gap-filler" radar data to a central coordinating system.

Faced with the problems of transmitting radar data to some remote point, a choice of several methods exists. The simplest is the use of some system which will transmit the video data directly, such as by a microwave relay link, or for very short distances, by a coaxial cable. For very short runs where a coaxial cable is practical, the advantages of its use are obvious. Maintenance of the electronic equipment which drives the cable represents the principal operating expense. For transmission over somewhat greater distances, a microwave relay link may be desirable. If the remoting can be done on a single hop without the need for repeaters, the original investment and maintenance cost may compare favorably with that for other means of data transmission. However, as the remoting distance increases to the point where several repeater stations are necessary, a low-bandwidth data transmission system which can operate over ordinary communication circuits becomes more attractive.

On several occasions, I have had people inquire whether the suspension of some of the natural laws is not necessary in order to transmit satisfactorily a radar PPI picture over a narrow-band channel. Since a typical video signal coming from a radar contains frequency components up to 2 or 3 megacycles, such a question is not completely unreasonable. However, when one considers the amount of information which can be conveyed from a PPI picture to a radar operator, one will find that the bandwidth involved is relatively small.

Considering the face of an indicator as a collection of elemental areas (the illumination of any one of which might denote a target), we find that the number of such elemental areas might reasonably total somewhere between 10,000 and 500,000. If 500,000 elemental areas were assumed, it is doubtful whether an operator could detect the movement of a target from one elemental area to an adjacent one. If as few as 10,000 elemental areas were assumed, the picture would be considerably coarsened. However, an operator could estimate the position of a target to nearly the accuracy possible with an ordinary radar PPI display. The pertinent question, as far as bandwidth is concerned, is how many of these elemental areas must we transmit each second in order to keep pace with the radar antenna as it turns. As a specific example, consider the problem of remoting the data from a SAGE Gap Filler radar. If we divide our PPI indicator face into 256 azimuth elements, each of these azimuth elements will be a wedge radiating from the center of the indicator and about 1.4° in width. Since 1.4° is in the neighborhood of the beam width of most short-range radars, the quantizing of a PPI picture into such angular elements will introduce a loss of angular resolution in the order of half the beam width. Let us also divide each azimuth element into 64 range elements. Considering the picture as a whole, we now have 16,384 elemental areas. For those who may be wondering why we chose such numbers as 256 and 64, I'll mention that they are powers of 2 which makes life much easier on most digital equipment. Let us also assume that we have an antenna rotating at about 5 rpm. We then have a total of 81,920 elemental areas per minute or 1365 elemental areas per second to transmit. The transmission of this number of bits per second over an ordinary telephone line or radio communication channel presents no real problem.

A PPI picture, as reconstructed at the receiving end of the communication channel, contains nearly all the intelligence available in the original radar signals. Assuming this to be the case, why do those original radar signals contain such high frequency components? One answer which the less charitable of you will immediately offer is that we have coarsened the picture. This, of course, is true, but to what extent have we coarsened the picture? By what factor have we increased the size of the elemental area? Surely by not more than a factor of 10. Perhaps then, more bandwidth is occupied by the radar signals than the PPI display that they create justifies. For instance, we might reduce the bandwidth in the video amplifier to 1 megacycle without noticing any change in the PPI picture. Even then, there is still a factor of about 60 to be accounted for somehow. Sure enough if we watch carefully, we find that the radar set is not content to transmit only one pulse each azimuth element and develop its picture on the basis of the information from that one pulse. It is instead transmitting somewhere in the neighborhood of 50 or 60 pulses per azimuth element—a rather considerable redundancy. Before we leap in and criticize the radar for inefficiency, we should recognize that the velocity of radio propagation being what it is, a single transmitted pulse each beam width would leave the radar unoccupied most of the time. It also would leave us with the same bandwidth as if the pulse were being repeated frequently. Because of this fact alone, we can afford to be magnanimous and not ask the radar set to transmit only pulse per azimuth element. It appears that we cannot hope to make the radar set by itself deliver low-bandwidth signals which may be transmitted to a remote point.

Even if the processing for data transmission were made easier by utilizing a single radar pulse per azimuth element, the performance of the radar would be very seriously degraded. It is difficult, when examining the video waveform resulting from a single radar pulse, to differentiate targets from noise. However, when the integrated result of a large number of transmitted pulses is examined, the repeated target returns stand out clearly in the presence of random noise. It can be said that the repetition of the target return over a larger number of radar trigger periods is redundant. However, this redundancy and subseqeunt integration are necessary in maintaining a reasonable radar sensitivity.

I believe we have shown that a radar PPI display may be transmitted over a narrow-band channel without excessive degradation of that picture. The problem is to devise a processing method to convert the radar video signals into narrow-band signals for transmission. One simple method might be to set up a television camera in front of the PPI indicator. If the scanning of this camera were made extremely slow so that one frame was completed for each rotation of the radar antenna, a usable remote display might be achieved. There would be a number of very serious "bugs" which would have to be ironed out of such a system. In addition, it probably would be difficult to maintain the stability necessary to permit coordinate measurements to be made on the resulting remote display. Even though serious faults are obvious in this system, let us examine the process of bandwidth reduction which it employs. The PPI phosphor performs an integrating function, building up a discernible target display from repeated returns. The television camera treats the picture as a series of horizontal lines, each having the width of an elemental area. As each horizontal line is swept, the television camera, in effect, treats it as a series of elemental areas.

Let us make an improvement on this television camera system.

Instead of a conventional television scan, let us make the scan polar, lagging an azimuth element or two behind the PPI scan as it rotates around the indicator. This eliminates some of the "bugs" from the system but, unfortunately, adds others. Again, it would be extremely difficult to maintain accuracy and stability in the system so that coordinate measurements could be made from the resulting remote display. The basic principle used here, however, has been successfully employed in slightly different fashion in other equipments.

The Rafax Bandwidth Compressor, developed at Haller, Raymond and Brown, starting in 1948, employs this same basic principle. In this equipment, a circular sweep is generated on a small cathode ray tube with a sweep being initiated by each radar trigger. The radar video signals are used to intensity-modulate the trace. Targets then show up as intensified spots whose angular positions on the tube are determined by their ranges. Using a medium persistence phosphor, the decay time of each target presentation is roughly the period necessary for the radar to turn through one beam width. A rotating optical pickup system feeding into a photo-cell is placed in front of this cathode ray tube. If this pick-up system is rotated at a speed so that one rotation is competed during each azimuth element, the signal from the photo-tube constitutes a slowed down version of the original video suitable for transmission over a narrow band channel. Many of the difficulties we found in our hypothetical television systems are avoided in Rafax. It is possible to maintain relatively accurate range and azimuth calibration. The principal weakness of such a system is the use of a phosphor for short-term storage. If the phosphor maintained its initial intensity until the scanning system read out each target and then caused that intensity to drop to zero, the system would be near ideal. However, the time between the intensification of a spot indicating a target and the scanning of that spot may vary from near zero to the time necessay to rotate through one azimuth element. The result is a loss of several db in the ability to distinguish weak returns in the presence of noise.

Slowed Down Video

About 1951, the Slowed Down Video was conceived at the Air Force Cambridge Research Center. Later, practical models were developed at Lincoln Laboratory. The Lewyt Manufacturing Corporation was given the job of re-engineering this equipment into suitable form for use in the Sage system. The complete system of the Lewyt AN/FST-1 Coordinate Data Transmitter occupies four cabinets and consists of two independent channels, each capable of processing the data from a radar set and transmitting it over a telephone line. Automatic fault sensing circuits and remote control facilities are provided to permit substitution of the stand-by channel in the event of failure or marginal operation of the operating channel. Each channel is housed in a pair of cabinets, one containing complete power supplies, and the other the Coordinate Data Transmitter itself. Two middle cabinets house the two transmitters. Logic wiring on these racks is exposed to view. There are transparent plastic masks which cover the eight sub-racks, and which have provided in them slotted holes through which special test prods may make contact with appropriate test points. Also, there are a large number of pairs of neon lamps indicating the state or activity of a number of flip-flops. These neon lamps and the test points make it possible for a maintenance man to make adjustments or to identify and locate malfunctions within the equipment easily.

In the rear of each transmitter rack there are eight sub-racks of plug-in circuit modules. The relatively small number of different circuit modules used in this equipment and the ease of their replacement simplifies maintenance. Field maintenance of this equipment can be by substitution, with repair of defective modules being accomplished at depots. These plug-in circuit modules are constructed on printed circuit boards, resulting in a compact, reproducible package. Since this equipment was intended for ground station use, no premium was put on reduction to the smallest possible size. Reliability and ease of maintenance were of prime importance.

If the development of such equipment were undertaken today, it would undoubtedly take a radically different form. The present availability of transistors and magnetic cores would permit much more reliable and compact equipment.

This equipment was built for use in the Sage system, using as inputs the signals from a short range gap-filler radar set. It processes those signals for transmission over a single telephone circuit. The area covered by the radar set is treated as a number of elemental areas. Each such elemental area is about 1.4° in width and 1/64th the maximum range of the radar. This corresponds with the example which we treated before with our hypothetical data processing equipments. The basic principle of processing for narrow band transmission is also similar to our hypothetical examples. However, a number of refinements worthy of mention are used.

One of the essential parts of the system is a means of storage in which the high-speed radar data may be accumulated and later released for transmission. A Radechon barrier-grid storage tube was chosen to perform this function. In this application, a raster of up to 256 dots may be applied to the storage tube target. Each of these dots may accumulate a charge during a number of writing operations. When desired, a readout signal may be obtained from any one of these spots, more or less proportional to the amount of writing which had been done on that spot. Since the readout operation is destructive, all charge is erased from a spot and the accumulation of charge during subsequent writing operations may start from zero.

Each spot on the raster corresponds to a range element, giving a capability of 256 range elements, although only 64 are used in the current application of the equipment. As the video signal resulting from each radar pulse is received, the appropriate charge corresponding to the signals present in each range element is deposited in the storage tube. Once per azimuth element, the readout circuits work their way through the raster, one spot each 1/1600th of a second producing output pulses whose amplitudes are measures of the radar signals appearing in the range elements since the last readout.

The output signals from the storage tube circuits could be stretched and displayed on an indicator, giving a multi-tone presentation. However, the signals necessary to convey such a multi-tone picture would require more bandwidth to transmit than we can afford. In addition, a decision must ultimately be made as to whether a target does or does not exist. In most instances, the machine is more capable of making this decision than an observer at a remote indicator. Therefore, a threshold circuit is utilized following the storage-tube output to accept as targets for transmission only those signals exceeding a pre-determined level. The remote display will therefore consist of either no spot or the definite presence of a spot in each elemental area.

In writing into the storage tube, it would be practical to integrate the video signal returned for each radar pulse in each range element and to apply a proportional charge to the appropriate spot on the raster. However, a simpler input system having a number of advantages is used instead. The incoming video signals are passed through a threshold circuit causing a flip-flop to set up whenever this threshold is exceeded. A range mark generator is used to generate a train of pulses marking the boundaries of the range elements. A range mark pulse which occurs while the flip-flop is set is used to reset the flip-flop and also to apply a unit charge to the appropriate spot on the storage tube raster. The result is that a unit charge is deposited for any range element within which the video waveform exceeds the pre-determined threshold. Here again, we have allowed the machine to make a decision as to whether a target did or did not exist for the return from each radar pulse.

Recording the Signals

We have quantized in range by breaking the range into 64 elements, and we have quantized in amplitude at the input to the storage tube by permitting only "target" or "no target" signals to be recorded on the storage tube. The picture is broken into azimuth elements by reading out each range element once during each azimuth element. It appears, then, that we are asking the storage tube to count the number of target returns per azimuth element in each range element. At the output of the storage tube, the decision is made to transmit a target pulse if the count exceeds a pre-determined number. Actually, the storage tube is not a digital device but it is able to count to an accuracy of about $\pm 10\%$, which is adequate for this application.

As we had mentioned before, it is very difficult to distinguish the presence of a weak target in the video signal resulting from a single radar pulse; however, this is just what we are asking the input threshold circuit to do. We must expect that it will make frequent mistakes. We would prefer that the equipment as a whole transmit false alarms (or targets which do not actually exist) very seldom. On the other hand, we are interested in displaying targets which may be practically indistinguishable from noise. The input threshold level is therefore set so that when no target returns are received, quantized video pulses will be generated a certain percentage of the time due to noise alone. The threshold circuit following the storage tube is then adjusted so that it will produce an output due to the quantizing of noise alone, only infrequently. If the proper choice of both of these thresholds is made, the machine can have the ability to distinguish weak targets as dependably as a reasonably alert radar observer. In order to maintain such performance, the percentage of quantized video pulses resulting from noise alone must remain relatively constant. A variation of a fraction of a db in average radar noise amplitude could completely disrupt the operation of the equipment. It would be unreasonable to attempt to maintain a constant noise amplitude within the radar over long periods

of time; therefore, a type of automatic gain control is employed in the Slowed Down Video equipment.

One of the range elements near maximum range is monitored and a voltage proportional to the rate of quantized video pulses due to noise alone is generated. This voltage, amplified and averaged through an extremely long time-constant, is used to control the gain of the input video amplifier. Thus, a nearly constant percentage of quantized video pulses due to noise alone is generated by the input threshold circuit. When properly calibrated, the equipment is capable of operation without attention for indefinite periods of time.

Let's digress for a minute, and discuss one of the advantages of this type of input circuit—where digital integration follows amplitude quantization.

I'm sure most of you have had the misfortune to observe radar indicators whose display was practically useless because of interference being received from nearby friendly radar sets. I'm afraid "friendly" is perhaps a poor word to use here. About the only consolation at a time like that is the knowledge that the fellows who are jamming you are probably looking at the same kind of picture. This sort of interference is almost entirely cleaned up by amplitude quantization and digital integration. The mechanism for removing this interference is fairly simple. Such interference usually takes the form of intense spots displayed as dotted spirals of varying pitch, or even as apparently randomly distributed spots. The important point is that each one of these spots is the result of a *single* radar pulse from a nearby radar. If that single pulse happens to come from a high-powered set using a wide transmitted pulse, the presentation on an ordinary PPI might very well be as bright as the display of a strong target return. However, where the data processing consists of determining whether the video quantizer threshold was exceeded for a minimum number of radar pulses, the effect of such a single high intensity return is negligible since it does *not* repeat several times at one range during an azimuth element. The result is that even the most cluttered radar display will be cleaned up and transmitted without a significant increase in the false alarm rate.

I don't think it would be proper to engage in speculation or other possible applications of this digital integration technique for cleaning up radar interference. However, I suspect many of you recognize applications for such a clean-up where processing for low bandwidth data transmission is not a requirement.

I might mention that a good part of the bulk of this machine is taken up by auxiliary circuits. These provide for the sensing of faults, the automatic transfer of channels in case of faults, provision for control from a remote point and report back on the status of the equipment to that remote point, and circuits for the generation of test patterns and calibration signals used during maintenance or which may be initiated remotely.

Telephone Line Entries

Now a word about what actually goes out to the telephone line. Each 1600th of a second, the storage tube output circuits either do or do not generate a pulse signifying the presence of a target in the elemental area under consideration. The sampling of all 64 range elements is completed about every 1/20th of a second. Square modulating waveforms 1/1600th of a second in length are used to control a 2000 cycle carrier and transmit target data, an 800 cycle timing signal, and a synchronizing signal signifying the start of each Slowed Down Video sweep. These signals are mixed in the appropriate proportions and are delivered directly to a single telephone line for transmission to the remote station.

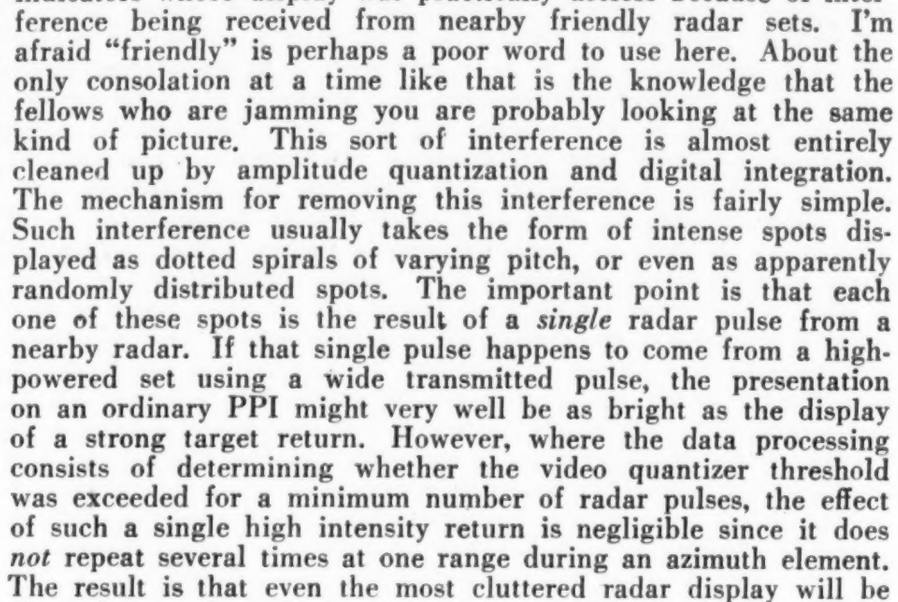
In conclusion I would like to mention the OA-947 Coordinate Data Monitor which is the indicator designed to display data received from the Slowed Down Video equipment. It contains all the circuitry necessary to demodulate the signals received from the telephone line and to reconstruct and display the PPI picture. Individual intensity control of target displays, range rings and north strobes are provided. In addition, other data may be displayed if desired. Over the indicator face, and normally stored at the top thereof, is a photo-electric light gun which may be positioned over any spot on the indicator and used to initiate the recording on adding machine tape of the range and azimuth coordinates of a target falling within its view.

The same type of modular construction for electronic circuits is used in this indicator as is used in the Slowed Down Video equipment. The door on the front of the equipment may be opened to expose the logic wiring. An inner door, consisting of the sub-racks housing the plug-in modules, may then be swung open to permit removal of any of the modules and also to provide access to the cathode-ray-tube-yoke drive. A back door provides access to power supplies.

Editor's note: Questions of security prevented the author from being more specific in some areas of this article.

Telegraphic Data

(*Continued from page 39*)



PREPARATION OF TAPE AT SENDING STATION

FIGURE 7

certain undesirable code combinations such as "blanks," which are deleted by some switching systems, and two consecutive "carriage returns" or "Figure Shift H," which are end-of-message signals in some switching systems.

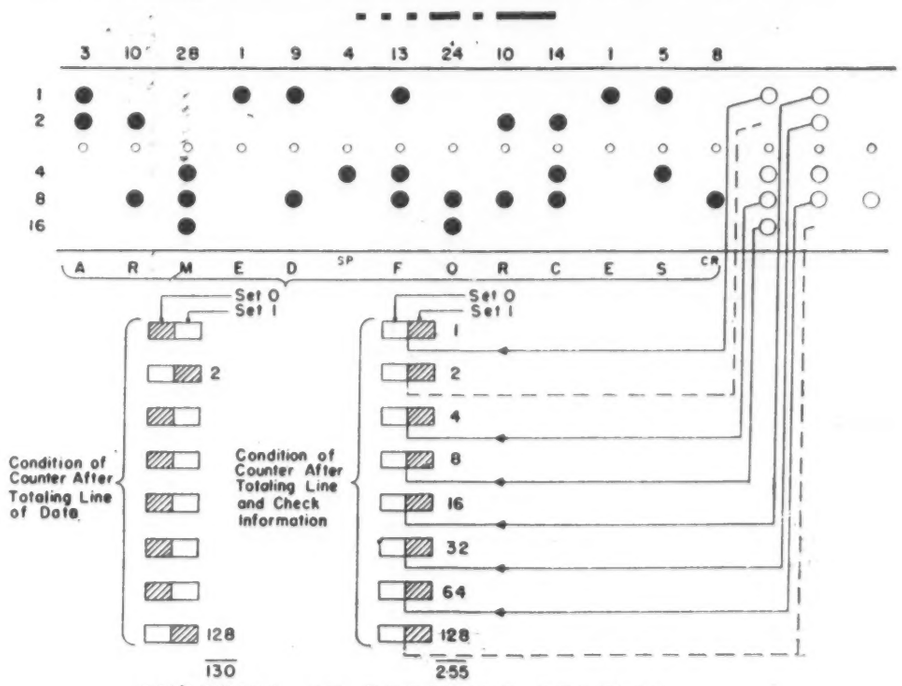
The carriage return is added after the two checking characters for control purposes, as will be explained later.

At the receiving end of the circuit, the sensing pins of the reperforator read the received characters into a binary counter. If no error occurs in transmission, this counter should have the total of 130 for the line of text illustrated in Figure 8. Upon detecting the end-of-line signal, the receiving equipment directs the 8 bits containing the checking information into their respective stages of the counter. Since these 8 bits are the complement of the binary total, every stage will be set to its "one" condition if there are no errors. Any deviation from all stages being set to one, will indicate an error.

If no error is indicated, the transmitter receives a signal that causes it to send the next line of data. If an error is indicated, the transmitter receives an "error" signal that causes it to back-step its tape to the "carriage return" code that terminated the checking characters of the previous line of data. Then upon a "ready" signal from the receiving station, it repeats the errored line. Meanwhile, the reperforator back-steps its tape and at the same time over-punches with five holes each character in the errored line. When its sensing pins read the "carriage return" code that terminated the checking characters of the previous lines, it starts stepping its tape in the forward direction until it reaches unpunched tape, when it sends the "ready" signal to the sending station.

The binary total gives an extremely effective error detection system with low transmission redundancy. Its totaling of the values of a group of characters gives protection against the loss or repetition of complete characters. If an error is confined to one character in a line, it gives positive protection on errors that would be compensating in the parity or fixed ratio codes.

At the present time, EDIT is essentially for point-to-point communications. However, it is evident that it has possibilities for use on a complicated switching network for automatically detecting and correcting data transmission over each link of the system.



CHECKING AT RECEIVING STATION

FIGURE 8

"re: *Your Signal of the 5th...*"

Some people still send communications one character at a time.

Others use DATAFAX—the fast Stewart-Warner electronic way to transmit all data over telephone lines.

Datafax transmits and records any material: correspondence, drawings, pictures, printed matter, even handwritten notes. And since copies are exact duplicate images of the original, chance for error is eliminated.

Cost?

Automatic transmission and recording eliminate need for full-time operator; recorders will even respond to transmissions sent after the office is closed for the day. Datafax also eliminates retyping, proofreading, intermediate handling, intransit delays—and their clerical costs. The clear, smudge-proof, permanent Datafax copy costs less than 2¢ for a letter-sized unit.

Chances are your operations have outgrown Primitive Communications. If so, you'll want to find out about Datafax. First, send for your copy of the free Datafax bulletin. Write: Stewart-Warner Electronics, Dept. 15, 1300 N. Kostner Ave., Chicago 51, Ill.

STEWART SW WARNER ELECTRONICS
a Division of Stewart-Warner Corporation

photoprogress

by FRANK SMITH
PHOTO EDITOR
SIGNAL

High Intensity Mercury Arc Lamps

News of an experimental development in lighting for night aerial photography which is creating no little interest in this field, is contained in a recent announcement of the Wright Air Development Center (WADC), Wright-Patterson Air Force Base, Ohio, which gives some details of the development. Present night photography systems use flash bombs or photoflash cartridges to provide intermittent light whereas the new method, developed by ARDC's Wright Air Development Center, utilizes a commercial type high-intensity mercury arc lamp to provide a narrow, directed beam of continuous light.

Although the active element (mercury arc) of the lamp is no larger than a cigarette, it provides adequate light for aerial photography. Excellent photographs have been obtained by Wright Air Development Center at various altitudes and speeds.

The lights are difficult to see from the ground because of their narrow beam and bluish hue. On an approaching aircraft, the light appears as a distant star to ground observers.

Standard flash bombs and cartridges produce a brilliant flash lasting only a fraction of a second, and dissipate light in all directions. Use of the mercury arc lamp enables Air Force reconnaissance aircraft to "sweep" light along the ground underneath the aircraft.

Air Force engineers in the Aerial Reconnaissance Laboratory at WADC pointed out that use of the light eliminates the need for heavy, bulky equipment used with pyrotechnic illuminants is much less expensive, and also safer, since no explosives are necessary.

In addition, the mission of a reconnaissance aircraft using the mercury arc lamp is limited only by the range of the aircraft and the amount of film carried.

The new method produces continual, constant-level light and works best with so-called aerial "strip" cameras which roll the film at a speed proportioned to the speed of the aircraft as it flies over the ground.

Lightweight Aerial Panoramic Camera

A versatile lightweight panoramic camera developed by the Perkin-Elmer Corp., Norwalk, Conn. for wide-angle aerial photography is expected to give new impetus to commercial as well as military use of aerial photo reconnaissance. The new camera, designated the Model 501 Lightweight Tracking Camera, is designed for diverse applications in military operations and other fields requiring extremely wide-angle continuous aerial photographic coverage of terrain.

The camera employs rapid-scanning principles to obtain successive photographs covering 180 degrees from horizon-to-horizon across a plane's line of flight, with true velocity compensation throughout the scan. It is an automatic sequencing camera with sufficient film capacity for a complete mission, and it can be set for either adjacent or stereo-overlapping pictures. Operation can be automatic or manual (preset), and can be started and stopped by remote control of power.

The camera is designed for 1000 feet of 70mm film with built-in red and yellow filter for black-and-white film and clear for color film and uses only 10½ inches of film for each horizon-to-horizon picture. The camera has the high resolution of 40 lines/mm on high-speed film and operates on 28 volts, D.C. power.

It contains no shutter, exposures being made while moving the film over a slit in the camera. Thus, as the prism rotates, the image is "wiped" on the sensitized film. The time required for each scan is adjustable, and can be set as fast as ¼ second.

These three, small lights mounted in the nose of a C-47 test aircraft provide sufficient, continuous light for night aerial photography.

Sound Reproduction

An interesting discovery which promises to have a significant effect on the foreign rescoring of Army training and other bi-lingual films, among many other possible uses, has been made by Mr. George Lewin, Chief of the Pictorial Engineering Office of the Army Pictorial Center, 35-11 35th Ave., Long Island City 1, N. Y.

Mr. Lewin has discovered that magnetic sound tracks

on motion picture film, previously believed to be opaque, are reasonably transparent to infra-red "light." This means that it will no longer be necessary to resort to half-width tracks when combined photographic and magnetic tracks are required.

The discovery also has important implications for the entire motion picture industry, since producers of multi-magnetic track films can place a full-width rather than half-width photographic track on their prints, along with the magnetic tracks, so that the same prints may be run in the many theaters which are not equipped for magnetic sound, without sacrificing picture area as is presently necessary. It is now possible to superimpose a magnetic stripe completely covering the full-width photographic sound track and still obtain good quality reproduction from it, while at the same time using the magnetic stripe for an entirely independent recording. The result, which permits maximum fidelity of sound from the magnetic track and only a slight loss of volume from the photographic track, is immediately applicable to the familiar JAN portable motion picture projector, a standard item of military equipment. These JAN projectors employ a lead-sulfide photo-conductive cell which is infra-red sensitive. By adding magnetic facilities, it will be possible for the projector to reproduce the sound from either track, as desired.

However, it is anticipated that additional tests will be necessary before it can be safely assumed that this newly discovered transparency effect is a permanent and commercially feasible one. Since the effect depends entirely upon the infra-red transmission of the magnetic oxide and the infra-red sensitivity of the lead-sulfide cell, it will be necessary to study carefully the uniformity of both the oxide and the cells. Proper selection and control are expected to reduce the transmission loss, and may at the same time improve the quality of both the photographic and magnetic reproduction. Improved cells and more efficient infra-red "light" sources are also a distinct possibility.

In a personal communication to the writer, Mr. Lewin stated that the transmission loss is approximately 11 db at 400 cycles. At 7000 cycles there is an additional loss of from one to three db, which can be recovered by refocussing for infra-red.

"*Photographic Science and Engineering*"

A new technical publication which has created great interest in scientific and engineering circles generally, and particularly those utilizing photography in some form or other, made its debut in July 1957 with the issuance of Volume 1, No. 1.

Entitled *Photographic Science and Engineering*, the new publication is a masterpiece of the editorial and publishing art and if the number of plaudits greeting its appearance is any criterion, it is certain to become a welcome addition to the very few publications covering the highly specialized field of photographic science and engineering. The new periodical which initially will be published quarterly, is the official journal of the recently formed Society of Photographic Scientists and Engineers which was created as a result of the union of the former Society of Photographic Engineers and the Technical Division of the Photographic Society of America. The new journal replaces the Society of Photographic Engineers' former official journal entitled *Photographic Engineering* and as such is dedicated to the advancement of the knowledge and application of photography and other directly related sciences.

The pages of the new journal are open to all who wish to report on new studies dealing with the theory of photosensitive systems, the design of photographic instruments and apparatus useful in the treatment of photographic materials, photographic optics and illuminants, the use of photography for scientific or engineering measurement or recording, and photographic instrumentation and data recording.

The first issue of *Photographic Science and Engineering* is a publication of 44 pages with six excellent papers covering the broad field of the subject and two departments covering literature abstracts and new developments and patents. Later, it is planned to add a book review department which will cover pertinent books as they are published.

Inquiries concerning the publication should be addressed to the Society of Photographic Scientists and Engineers, Box 1609, Main Post Office, Washington, D. C.

"*Modern Applied Photography*"

Since we are on the subject of literature, particularly that which applies to photographic science and engineering, it is pertinent that your attention be called to a volume of 162 pages just published by the Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y.

Authored by G. A. Jones, a recognized expert on the subject of photographic instrumentation, *Modern Applied Photography* is a summary or outline, and a very good one too, of the major applications of photography, and, as stated by the author in the preface, is directed towards those not mainly concerned with the art or science of the subject. To that end, as far as possible, technical terms have been omitted, though it has been assumed that the reader possesses a general knowledge of elementary photographic principles. In this book he draws upon his experience to survey the scope of applied photography in most major branches of industry, emphasizing its value in research and investigation as well as in simple recording. All major modern techniques are explained, with the reasons underlying their uses broadly analyzed in terms of the fundamental properties of light-sensitive photographic material. For the practical man, many examples are included of applied photography in a wide variety of industries.

The book consists of 12 chapters, a bibliography and index, plus a list of plates of which there are 18. Some idea of its comprehensiveness may be gained from a perusal of the chapter titles which include, "Photography As an Aid to Memory;" "Scientific Recording;" "Photography by Dim and Bright Light;" "Recording of Color," "Infra-Red Sensitivity;" "Ultra-Violet Photography;" "Radiography;" "Atomic Particles;" "Recording and Analysis of Motion;" "Photography in Production," and "Photography as an Instructor."

Well written and technically authoritative, Jones' book is certain to find wide acceptance as a brief but excellent outline on the subject of applied photography which reduced to its simplest terms is photographic instrumentation. Priced: $4.75.

"*Wollensak Lens and Shutter Guide*"

Another recent arrival in the field of literature pertaining to the subject of photography, at least that part of it concerning lenses and shutters, is a small paper bound volume of some 126 pages entitled *Wollensak Lens and Shutter Guide*, published by Greenberg, 201 East 57th St., New York 22, N. Y.

As indicated by the title, the book covers Wollensak lenses and shutters plus a chapter on Wollensak high speed motion picture cameras and for the first time offers to the photographer who wants to know, a complete

(*Continued on page* 48)

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and fully illustrated guide to the lenses and shutters of the Wollensak Optical Co. The book deals with lenses and shutters in general and particularly covers lens aberrations, lens construction, lens mounting, depth of field, lens coverage, resolution, lens coating and cleaning, enlarging lenses, image size, color, light and shutter synchronization.

Particularly interesting is the chapter on Wollensak high speed motion picture cameras which introduces some of the fundamentals of this fascinating art.

Though the book covers the products of only one manufacturer, it is broad enough in its coverage to be of interest to any one who desires to know more about the two basic elements of any camera system. The book reflects great care in its preparation, is technically accurate, authoritative and as complete as a book of its size could be. It is well illustrated and priced $1.95.

SPSE 1957 Annual Technical Conference

An event of great importance in the field of photographic science and engineering was the 1957 Annual Technical Conference of the Society of Photographic Scientists and Engineers, held at the Hotel Berkeley-Carteret, Asbury Park, N. J., Sept. 9 to 13, 1957, with the cooperation of the U. S. Army Signal Engineering Laboratories, Fort Monmouth, N. J.

Brigadier General Earle F. Cook, Commanding the U. S. Army Signal Engineering Laboratories at Fort Monmouth, N. J., delivered the welcoming address. General Cook discussed the newer concepts of military photographic requirements and the role that industry could play in fulfilling the needs of the Department of the Army in the photographic aspect of the combat surveillance program.

During the conference, Dr. John Eggert, Director of the Photographic Institute at the Technical College in Zurich, Switzerland, was awarded honorary membership by the Society in recognition of his contributions and achievements in the field of photographic science. Dr. Eggert's technical paper, "Photographic Development in Theory and Practice," was well received and excited great interest among his audience.

A representative cross section of other papers presented included "Multiflash Photography," by Dr. Harold E. Edgerton; "Airborne Photographic Processing," by C. N. Edwards, S. Schreck, and A. G. Hutchins; "Improvements in Densitometry," by Albert J. Derr; "The Use of Electronic Image Intensification in Cinefluorography," by J. H. Tolan and J. L. DeClerk, and "The LogEtron—1957," by Dwin R. Craig. Some 36 papers in all were presented covering many of the multitudinous facets of photographic science and engineering.

One of the most interesting features of the conference was the equipment exhibit which was unusually good. Some 20 exhibitors, including the U. S. Army Signal Engineering Laboratories at Fort Monmouth, N. J., displayed their latest and most up-to-date developments. Bell and Howell Co. of Chicago, Ill., was easily the exhibitor with the largest number of new equipments on display, having twelve altogether.

Some of their outstanding items included the new CBVM-JAN type 16mm magnetic television projector; the new 240 EE 16mm automatic threading electric eye camera, and a 35mm and 16mm electric scoring camera, the latter with Globavision lens.

LogEtronics, Inc., exhibited their latest development of the LogEtronic printer with automatic dodging and automatic exposure control. Zoomar, Inc., exhibited several

of the newest developments in lenses and their new 360 degree Panoramic Camera.

Foreign exhibitors also were on hand, among them being Andre Debrie of France with the Aiglonne Model D daylight-film developing machine which is available in 16mm and 35mm negative-positive, and 16mm reversal types. Canadian Applied Research, Ltd., of Canada, displayed and demonstrated their Type T 246 Automatic Tri-Film Processor, the Type T 232 MK 8 Aerial Camera and the Type T 232 MK 7 Instrumentation Camera.

All the items displayed by the various exhibitors were new and equally interesting but lack of space prevents even a short resume of them in this column. However, mention should be made of the excellent display of several late photographic developments of the U. S. Army Signal Engineering Laboratories, chiefly among which was the Processing Machine, Photographic Film and Paper, EH-28( ) for forward area photographic processing. Technical information accompanying the display stated that the machine processes both film and paper in 70mm, 5" and 9½" widths and 200' long with full daylight operation. The machine utilizes the recently developed High Temperature Signal Corps Stabilization Process which was developed at the U. S. Army Signal Engineering Laboratories. The equipment is used with and is part of the Signal Corps Laboratory Darkroom, Semi-Automatic, Division Area. Speed of the machine is 2½' per min. for 9½" wide film, 5' per min. for 5" film and 15' per min. for 9⅜" paper.

The significance of this display indicates that military photographic processing is no longer a rear area operation but that it has moved right up to the combat area.

The Society plans to hold its next annual conference in October 1958 at Rochester, New York.

Flight Research, Inc.

Flight Research, Inc., Richmond, Va., have announced a new 70mm missile-tracking camera, designated Multidata Model V. Specifically designed for missile tracking, the new camera provides greater magnification and higher resolution than that provided by cameras using smaller film sizes. The 70mm film used permits a 2¼" x 2¼" frame size which minimizes the effect of tracking error and helps keep the missile within the frame.

The camera accepts 400 or 1000 foot magazines and lenses are interchangeable. Other features of the camera include a timing system of two neon lights which provide visible coding on both edges of film for perfect correlation with time base; four lighted fiducial markers which indicate centerlines of aperture to within 0.001"; adjustable shutter from 0 degrees to 120 degrees, and automatic output pulse which indicates center of exposure at any shutter opening. As missiles go farther and faster, the larger field of view and greater magnification provided by 70mm film result in a great increase in tracking range and increase in detail that can be seen in fins, exhaust patterns, nose cone, missile attitude and other important aspects of the missile in flight.

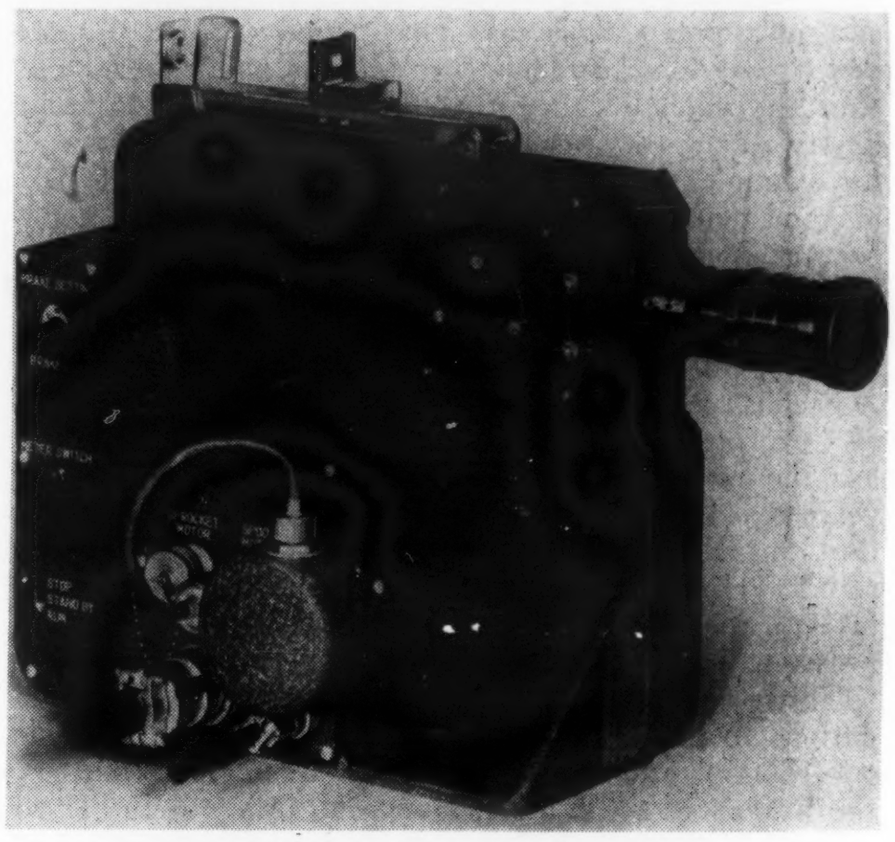
Fairchild Camera and Instrument Corp.

From Fairchild Camera and Instrument Corp., Industrial Camera Division, Jamaica, N. Y. comes news of a new 16mm motion analysis camera, Model HS-401. With its interchangeable motors it provides picture taking rates of 10 to 80 p.p.s.—25 to 300 p.p.s.—200 to 1500 p.p.s.—500 to 2500 p.p.s. and 800 to 6000 p.p.s.

The manufacturer states that although the camera weighs only 24 lbs. with its double motor set, it is really a lightweight and produces clear, smear-free and jitterless pictures at all speeds. It is delivered with your choice of 13mm, 75mm, 102mm, or 152mm lens, and can be used with the Fairchild battery pack at speeds up to 4500 p.p.s. Its motors, lenses and auxiliary equipment are interchangeable with the HS-100 and HS-101 models.

The camera is provided with an open sight which features focal length and parallax correction. A boresight slips easily into the port on the camera. Size of camera (with 75mm lens) is 9" x 13¼" x 16-13/16".

Features of the camera include dynamic and electromagnetic braking which provide maximum efficiency in rapid start-stop applications. This permits repeated short bursts at all speeds up to 6000 pictures per second.



Fairchild HS-401 Motion Analysis Camera

Photographic Instrumentation Developments

Developments in this field seem to have been accelerated during the past two months due no doubt to the recent annual (September) technical conference of the newly formed Society of Photographic Scientists and Engineers and the 82nd October convention of the Society of Motion Picture and Television Engineers.

During the above period, one of the leaders in this field, the Wollensak Optical Co., Rochester, N. Y. announced several new items chief among which is their new TL 35 time lapse camera.

The TL 35 is a data recording time lapse camera designed to photograph panels, meters, gauges, instruments, mechanical devices, etc. for time study and sequence analysis of movement. Each exposure is made at a predetermined interval depending upon the motor used of which there are many available to obtain various time lapse intervals from one picture every six seconds to one picture every 30 minutes.

The camera uses 35mm film (picture format 23.8mm x 25.4mm) wound on 50 foot daylight loading spools. It is equipped with a Wollensak Amaton 35mm f/3.5 lens, a No. 0 Alphax shutter and 6-volt D.C. motor using 0.1 amperes. Dimensions of the camera are 6½" x 4-13/16" x 2-27/32" and weighs 2½ lbs. Accessories such as a finder, terminal block, footage counter, etc., can be supplied.

In addition to the above, Woolensak has announced their new Model WF-17 16mm 100-foot picture Oscillo

(Continued on next page)

SIC...why is it? what does it do? who does it affect?

William F. E. Long, Manager, Marketing Data Dept. E. I. A.

THE STANDARD INDUSTRIAL CLASSIFICATION (SIC) IS the system by which the Federal Government defines the American economy in terms of 1,100 groups of industries and sub-industries for the purpose of gathering data to be used as the basis of legislative, fiscal, mobilization and other policy decisions. Thus explained, it is obvious that SIC is vital to management, labor and Government. And SIC which does not give proper recognition to an industry can result in serious damage to that industry as, for example, through unwise tax policy (due to the lack of good official Government statistics) or through a disproportionate allocation of scarce materials. To labor, SIC can mean a real loss or gain in the pay envelope through Walsh-Healey determinations, Social Security benefits, etc.

Because SIC is one of the most important foundations of Government policy, the Bureau of the Budget, which has the responsibility for maintaining SIC, about five years ago began to work on a revision of the classification, to make it more representative of our dynamic and rapidly changing economy. An unprecedented undertaking resulted, consuming the time of hundreds of businessmen, and many man-years of Government effort.

Thirty-five industry committees made 2,500 recommendations to the Technical Committee on Standard Industrial Classification in the Office of Statistical Standards of the Bureau of the Budget, Executive Office of the President. The Technical Committee acted on recommendations in accordance with the following principles:

(1) SIC should conform to the existing structure of American industry. For the purposes of the SIC, the structure is separated into a number of divisions, such as Agriculture, Mining, Construction, Transportation, Communication, Wholesale and Retail Trade, et cetera, in addition to Manufacturing.

(2) The classifications should be based on the characteristics of plants rather than companies.

(3) Each plant should be classified in that industry which describes its major product.

(4) To be recognized as an industry, each group of plants must be "significant" from the standpoint of the number of persons employed, volume of business, and other important economic features such as the number of establishments.

In view of the above principles, it is difficult to understand some decisions of the Technical Committee. For example, Electronic Industries form an important part of the existing structure of American industry. They are the fifth largest industry group. Yet, in the SIC, Electronic Industries are not recognized as a major 2-digit industry, such as Major Group 36, "Electrical Machinery, Equipment, and Supplies." On the contrary, Electronic Industries, whose fruits affect our lives through television, industrial controls, electronic computers, missiles and hundreds of other products, are concealed and buried within the Electrical Machinery Industry Group which they resemble about as much as the airplane resembles the kite.

However, some gains were registered in the 1957 edition of Standard Industrial Classification Manual over the 1945 edition which it replaced. Electronic Components and Accessories were given a 3-digit industry group (367) and two other 3-digit groups—365 and 366—were established. This compares with one—366—in the 1945 edition. Unfortunately, the titles are not properly descriptive, and a number of important activities of plants in the electronic industries are to be found elsewhere in the structure. Furthermore, while the Electronics Industries plants account for more than half of the employment in Major Group 36, they were given only three 3-digit groups compared with five for the establishments producing such products as switchgear, motors, generators, sewing machines, and lighting fixtures. It is not too early for the members of the electronic and communication equipment industries to begin to develop an adequate Standard Industrial Classification for the next edition.

PHOTOPROGRESS

Fastax high speed camera which enables one to record photographically combined picture and oscillo recording of an event where electrical and mechanical data are desired. The camera can also be used for either picture or oscillographic recording independently of each other.

Camera speed is from 150 to 8000 p.p.s. (5 ft. per second to 200 ft. per second). Two lenses are furnished, both of which are 50mm f/2 Fastax raptars in focusing mounts, one of which is for the picture image and the other for the oscillograph trace which is recorded simultaneously with the picture record. The camera is furnished with integral viewfinders and removable reflex finders and timing light.

Two motors are furnished (115 volt AC-DC 60 cycle), one for drive and one for take-up. Size of the camera is 12" x 12" x 12" and the weight is 25 lbs. Price is $2250.00.

The Konica Hand-Held Aerial Camera

A new hand-held aerial camera of Japanese origin has been announced by the Konica Camera Co., 76 West Chelten Ave., Philadelphia 44, Pa.

The camera is a precision, spring-driven fast shooting aerial camera for spotting or general aerial photography. The spring-drive permits 10 successive exposures within 15 seconds with a single click of the release button. The camera may be equipped either with a Hexanon f/3.5 135mm or a Hexanon f/3.5 85mm lens. Aperture stops are f/3.5, f/4, f/5.6, f/8, f/11, f/16 and f/22. Shutter speeds are 1/50th, 1/100th, 1/200th and 1/400th second.

The camera uses standard 120 roll film and produces a picture 2¼" x 2¼" in size and is equipped with a sports type finder with framed prism and cross hairs etched in prism with center marker for level alignment.

The camera with lens weighs 6 lbs. Overall size is 9¾" x 6¾" x 6". List price $650.00.

Sparrow I

(*Continued from page* 15)

factured at reasonable costs on a schedule which meets Navy requirements. As a result of the achievements on this program, the U.S. Navy's supersonic Sparrow I air-to-air guided missile system is now in a combat-ready status. Squadrons of the Navy's operational jet interceptors armed with the missiles are deployed on carriers in both Atlantic and Pacific Fleets. Other Sparrow I missiles are operational with all-weather squadrons of the U.S. Marines at shore bases. The Sperry Sparrow I now is on guard day and night around the world for Naval fleet units and shore installations.

Sparrow Accuracy

United States Navy and Marine pilots have demonstrated the high reliability and deadly accuracy of the Sperry Sparrow I Weapon System by hundreds of missile launchings against target drones. The lethal warhead has blasted out of the sky all types of targets including highspeed jet aircraft and missiles.

The Sparrow I guided missile system is undoubtedly the most versatile weapon used for arming Naval aircraft. Previously, attacking enemy aircraft might have escaped detection by operating under conditions of poor visibility or by cloud screening. Now, the Sparrow I guidance system can aim the missile directly at the target in spite of the inability of the pilot "to see;" destruction of the enemy aircraft by the lethal warhead is assured. Versatility of the Sparrow I Weapon System has been proven by effective attacks against high and low-altitude targets flying either singly or in groups.

R&D Pays Off

The present readiness of the fleet with this highly reliable and effective air-to-air missile system results from years of intensive development by the Navy's Bureau of Aeronautics and Air Missile Test Center, and the Sperry Gyroscope Company. The delivery of Sparrow I missiles in production quantities to fill the magazines of aircraft carriers with this "new type of ammunition" is a result of proficient plant operation with exceptional quality control at the Sperry Farragut Company. This competent human effort directed by the National Defense authorities has produced a weapon that is a powerful deterrent against a surprise atack by enemy aircraft.

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Association affairs

Honor Graduate Awards

Eleven officers graduating with top honors at the United States Army Signal School were recently presented the AFCEA Award for outstanding achievement.

Highest percentiles in the Signal Officer basic course were held by the following:

Section 751 — Second Lieutenant Robert E. Hill, 212 N. Broadway, Hobart, Okla. EE, U. of Oklahoma.

Section 752 — Second Lieutenant Stuart K. Yuill, Box 404, Rt. #1, Lanham, Md. EE, Johns Hopkins U.

Section 753 — Second Lieutenant Ward R. Kelley of 3009 S.E. Rex, Portland, Ore. ME, Oregon State College.

Section 754 — Second Lieutenant Thomas K. Batson of 1308 Second Ave., Bessemer, Ala. CE, Alabama Polytechnic Institute.

Section 755 — Second Lieutenant Paul D. Carmichael, Jr., 368 Burton Ave., Washington, Penna. EE, Carnegie Institute of Technology.

Section 756 — First Lieutenant Richard V. Morris of 9 Evergreen Ave., Bedford, Mass. EE, Rensselaer Polytechnic Institute.

Section 757 — Second Lieutenant John R. Cummings, 21 Chestnut St., Westfield, N. Y. EE, Rensselaer Polytechnic Institute.

Section 758 — Second Lieutenant Robert S. Lowrey, Jr., RFD 1, Rome, Ga. Animal Husbandry, U. of Georgia.

Section 701 — Second Lieutenant George C. Smolenyak, 697 Brookside Rd., Rahway, N. J. Natural Sciences, Seton Hall U.

Section 702 — Second Lieutenant Charles R. Pendred, 4525 Cooper Ave., Merchantville, N. J. EE, U. of Pennsylvania.

Section 703 — Second Lieutenant Leon P. VanSpeybroeck, 253 N. Madison, Wichita, Kans. Physics, Massachusetts Institute of Technology.

The Signal Officer basic course provides basic branch training for newly-commissioned officers. It is designed to give a working knowledge of the duties and responsibilities which the officers may expect during their early service with the Signal Corps.

Captain Carl Dennis of 604 East Main Street, Benton, Illinois, and Captain George M. Best, 105 Madison Avenue, Walsenburg, Colorado, Section 302, took high honors academically in the Signal Company Officer Course (Branch Transferees). The course is designed to provide branch training to officers so they will be thoroughly grounded in the duties and responsibilities appropriate to company grade Signal Corps officers.

First Lieutenant Edmund J. Creamer, Jr., 616 East 29th Street, Baltimore, Maryland, from Section 3708 of the Electronic Warfare Officer Course, took top academic honors. This course trains officers to direct and supervise electronic countermeasures activities.

First Lieutenant Lawrence D. Davis, 851 Brill Street, Philadelphia, Pennsylvania, took high honors in Section 502 of the Field Grade Officer Refresher Course. This course provides refresher training in tactics, techniques and material appropriate to Signal Corps company and field grade reserve component officers.

AFCEA's New Group Member

The AFCEA recently welcomed Stoddart Aircraft Radio Co., Inc., of Hollywood, Calif., a firm which deals with electronics research and development, and the manufacturing of radio interference and field intensity measuring equipment.

Members of the firm who will be company representatives in AFCEA are: Richard R. Stoddart, president; John R. Stevenson, administrative ass't.; J. D. Nightingale, personnel manager; Alfred T. Parker, chief engineer; Donald S. Radmacher, ass't. chief engineer; Gerald O. Essex, staff engineer; William T. Glasspool, project engineer; Vernon O. Moore, project engineer; D. M. Hish, project engineer; Gerald P. Rothhammer, field engineer.

Can you use the talent that built 1,500 Y-4 bombsights on schedule?

These General Mills technicians are representative of the production talent that built more than 1,500 Y-4 bombsights, 1,500 coordinate converters, 1,400 azimuth and sighting angle indicators and 1,400 amplifier and power supply units—and, delivered them to the Air Force *on time*. Here the men inspect a bombsight before it progresses to the next stage of production.

Because we have the highly skilled men—and the men have the specialized tools and machines—we produce precision piece parts or complete, complex assemblies to meet the most exacting requirements.

While building the Y-4 bombsight, we improved original design, exceeded USAF specifications. In addition, our thorough testing facilities assured delivery of only perfect instruments.

Such performance has come to be expected of us and has benefited many other customers. We'd like to help with your production problems too.

Booklet Tells More, explains mechanical and electro-mechanical production facilities. Send to Dept. SG-11, Mechanical Division, General Mills, 1620 Central Ave. N.E., Minneapolis, Minn.

No slow-downs for the B-47—Bombsights ready in advance! During production of the B-47 Stratojet, not a one was kept from the ready-line for lack of a bombsight. The same developmental, engineering and production skills that gave the Air Force on-time delivery are available to speed production of your products.

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AFCEA Group Members

Communications—Electronics—Photography

Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Admiral Corp.
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Ampex Corp.
Amphenol Electronics Corp.
Anaconda Wire & Cable Co.
A. R. F. Products, Inc.
Arnold Engineering Co.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Autonetics, Division of North American Aviation, Inc.
Barker & Williamson, Inc.
Barry Controls, Inc.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Blackburn Electronic Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Compagnie Francaise Thomson-Houston
Convair, Division of General Dynamics Corp.
Cook Electric Co.
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Dana, P. A., Inc.
Designers for Industry, Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corp.
DuKane Corp.
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Electronic Communications, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Co.
Federal Telecommunication Laboratories
Federal Telecommunication Laboratories, Division of West Coast Labs.
Federal Telephone & Radio Co.
General Aniline & Film Corp.
General Cable Corp.
General Communications Co.
General Electric Co.
General Telephone Corp.
Gilfillan Bros., Co.
Globe Wireless, Ltd.
Gray Manufacturing Co.
Hallamore Electronics Co.
Haller, Raymond and Brown, Inc.
Hallicrafters Co., The
Haloid Co.
Hazeltine Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hercules Motor Corp.
Hitemp Wires, Inc.
Hoffman Laboratories, Inc.
Hogan Laboratories, Inc.
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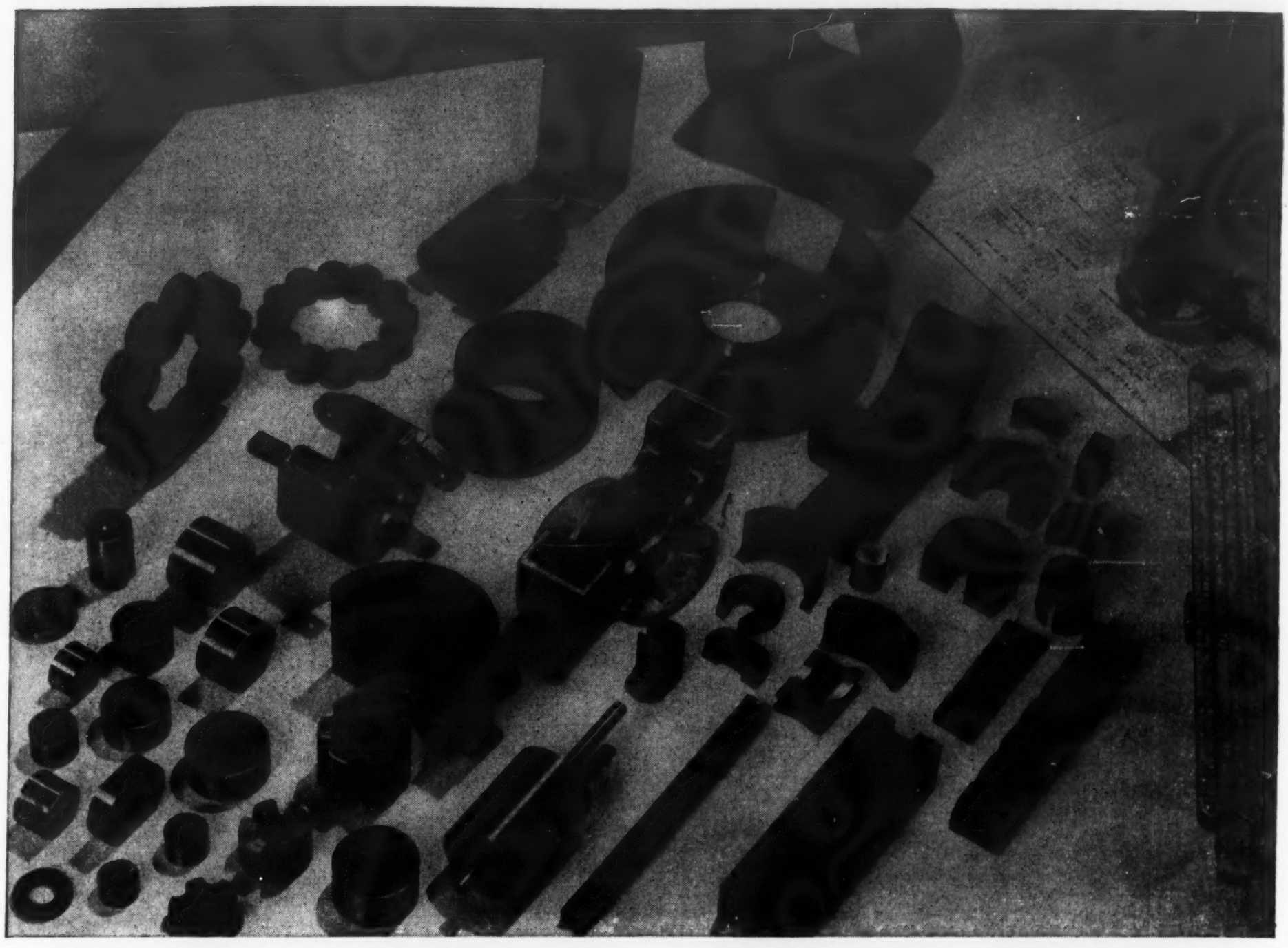

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Chapter News

Atlanta—Fort McPherson Officers' Club was the scene of the chapter's September 24th meeting. Photo at left shows Lt. Col. Donald L. Adams, chapter president, awarding a past president's pin to Charles M. Eberhart, 1956-57 president. At right, Southern Bell Telephone and Telegraph Company hostesses Hazel Hill (left) and Ruby Terry pin a name badge on Dr. Robert N. Lehrer of Georgia Tech, guest speaker, while President Adams looks on.

Atlanta

Opening meeting of the fall season took place at the Fort McPherson Officers' Club on September 24th, with 162 members and guests in attendance. Featured speaker was Dr. Robert N. Lehrer of the Georgia Institute of Technology who presented an illustrated lecture and a film on "Data Processing."

During the business session, Lt. Col. Donald L. Adams, chapter president, formally presented the past president's pin, an AFCEA gold lapel button, to Charles M. Eberhart, who had headed the chapter during the past year.

President Adams introduced the new chairmen appointed for the various phases of chapter activity as follows: membership—John W. Owen, Southern Bell Telephone and Telegraph Co.; program—W. O. McDowell, Southern Bell; reception—Lt. Thomas A. Pugh, Third Army Headquarters; civil defense—J. S. Bonner, Southern Bell; publicity—Clack Tucker, Southern Bell. The new secretary-treasurer, A. M. "Gus" Wilson of Southern Bell, was also introduced.

An additional feature of the evening was a program of entertainment presented by the Third Army's Special Service Section.

The chapter's next meeting will be held on November 19th, with a scientist from the Naval Research Laboratory conducting a special program on the earth satellite.

Baltimore

Capt. Leslie M. Slack, U. S. Navy, Bureau of Ordnance, Navy Systems Director, Surface Weapons Systems, conducted a program on shipboard guided missiles at the chapter's first meeting of 1957-58 at the Park Plaza Hotel.

Captain Slack, who was the officer in charge of the first Navy guided missile unit, presented an authoritative discussion, illustrated by motion and slide pictures, of some of the Navy's guided missiles, their handling and launching, and computer functions as the missiles track down and destroy their targets. In addition, John Rexroth, Captain Slack's civilian assistant, showed a film describing the production, installation and testing of the "Terrior" Weapons System.

Prior to the program feature, Capt. V. E. Day, commandant of the U.S. Coast Guard Yard, displayed a photograph of the Navy MSTS Task Force which had completed a third summer of activity in a strait in the Arctic which may become an escape route for vessels trapped above Point Barrow during the winter. Captain Day reported that three Coast Guard vessels had recently completed this route thus becoming the first vessels to circumnavigate the North American continent.

Chapter president Henry B. Yarbrough officiated at the meeting and outlined plans for the year's activities.

Baltimore—Shown at the opening meeting of the fall season on September 17th are, left to right: Rear Adm. George J. King, Bendix Radio; Capt. Leslie M. Slack, USN, principal speaker of the evening; Chapter President Henry B. Yarbrough; Leroy D. Kiley, Bendix-Friez; and George C. Ruehl, Jr., AFCEA Regional Vice President.

Boston

The senior Service commanders in the New England area were honored at the "kickoff" meeting of the fall season. Held on September 12th, the meeting took place at the Commissioned Officers Mess, Boston Naval Shipyard.

The commanders were: Rear Adm. John A. Snackenberg, USN, Commandant First Naval District; Maj. Gen. William M. Morgan, USAF, Commander Air Force Cambridge Research Center; Rear Adm. Edwin J. Roland, USCG, Commander First Coast Guard District; Maj. Gen. Sidney C. Wooten, USA, Commanding General Fort Devens, and Rear Adm. William E. Howard, Jr., USN, Commander Boston Naval Shipyard, host to the chapter.

A brief review of the activities of his command was given by each of the honored guests. Col. Murray D. Harris, PMST at Northeastern University, presided as the new president of the Boston Chapter.

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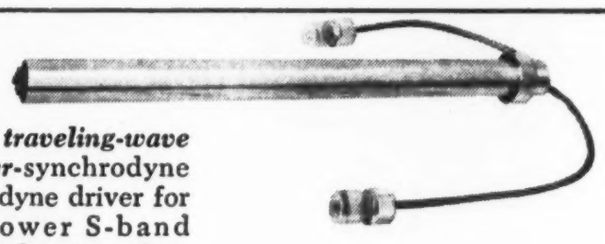

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Dayton-Wright

Committee chairmen have been appointed as follows to direct the various phases of chapter activity:

Willis K. Sutton, Summers Gyroscope Co.—membership; Jack Kinnally, Philco Corp.—publicity; John Wilkinson, American Phenolic Corp.—meetings; Harry C. Blackburn, Sylvania Electric Products—rules; Henry Taylor—budget; James J. Magill, Westinghouse Electric Corp.—arrangements.

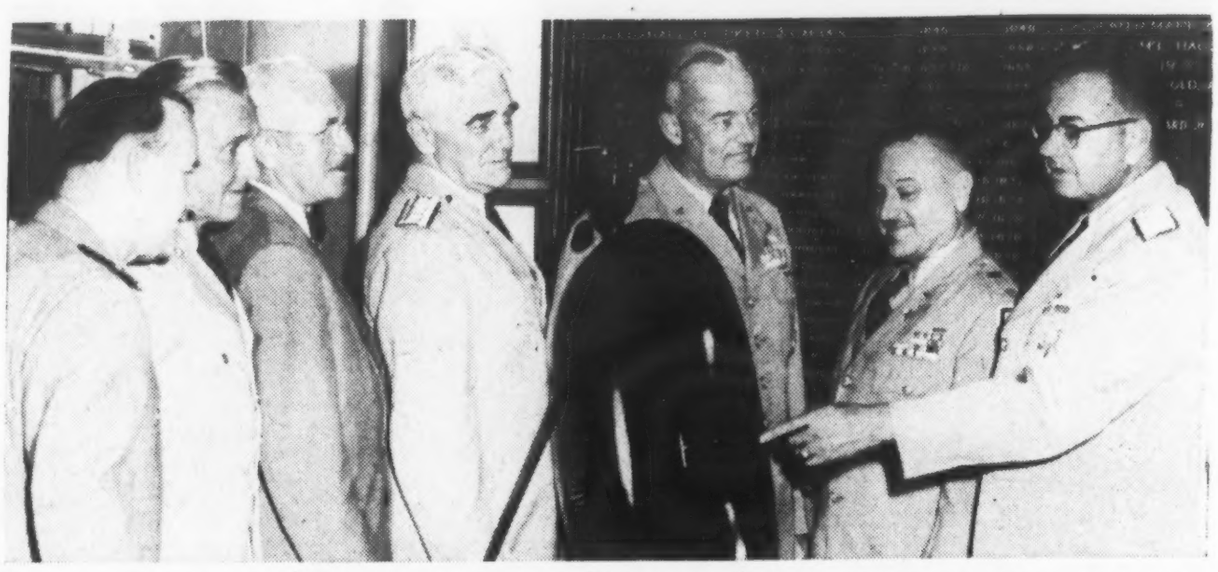
Fort Monmouth

William H. Foster, Associate Director of Research for the Philco Corporation was guest speaker September 19th at the opening dinner-meeting of the 1957-1958 season.

His talk, "An Aspect of Infra-Red," was made before a large audience of members and their guests in the Sapphire Room at Gibbs Hall Officers Club. The meeting was presided over by the chapter's new president, Halsey F. Hubbard of the U.S. Army Signal Equipment Support Agency. Mr. Hubbard succeeds Colonel Olin L. Bell, who left Fort Monmouth last July to take over a new assignment in Washington.

Fort Monmouth—Newly installed president of the chapter, Halsey F. Hubbard (left) is pictured with Maj. Gen. George L. Van Deusen, USA (Ret.), at the September 19th meeting.

Several other chapter officers took over their duties at the meeting. They were Colonel A. L. Burke, first vice president; Norman Freeman, second vice president; Harry C. Ross, secretary; and Miss Margaret Manuel, treasurer. Colonel Robert P. Haffa, Director of Evans Signal Laboratory, is the new chairman of the membership committee.



Boston—The chapter's September 12th meeting took place at the Boston Naval Shipyard. Pointing out anchor chain links used on the "U. S. S. Forrestal" is host Rear Adm. William E. Howard, Jr., commander of the shipyard. Looking on, left to right, are: Rear Adm. John A. Snackenberg, USN; Maj. Gen. William M. Morgan, USAF; Fred E. Moran, past chapter president; Rear Adm. Edwin J. Roland, USCG; Maj. Gen. Sidney C. Wooten, USA, and Col. Murray D. Harris, USA, chapter president.

Gulf Coast

The program for the chapter's September 9th meeting was presented by Roy Woodhouse of Bendix, who showed and discussed scenic slides taken in Alaska and described some of the problems of installing and maintaining equipment in the Far North.

The meeting was held at Gus Stevens Restaurant in Biloxi with Ancil Z. Arseneau, chapter president, presiding.

Kansas City

The earth satellite was the subject of the chapter's September 20th meeting, with N. Whitney Matthews of the Naval Research Laboratory conducting the program.

Mr. Matthews' talk, illustrated with slides, detailed technical information covering electronic developments of the proposed satellite. Also displayed to the group was a miniaturized, transistorized 48 channel encoder which Mr. Matthews had designed and built. Included in the talk was data for "hams" in the audience who were interested in attempting to receive signals direct from the satellite.

A number of officers and directors of the Astronomy Society of Kansas City were guests of the chapter.

At the conclusion of the meeting, Chapter President Don Meserve accompanied Mr. Matthews to Station WDAF-TV where the latter was interviewed on "The Closer Look" news program.

Louisiana

Col. W. J. Given, Officer of Civil Defense, State of Louisiana, spoke on "The Problems of Communication Planning for the State of Louisiana" at a chapter meeting held at the Naval Air Station, New Orleans, on August 5th.

Guests of the chapter were: Dr. William P. Gardiner, Director, Board of Health; Col. James A. Moreau, Deputy State Director, Selective Service; Father Carl Schutten, Pastor, St. James Major Church; Lt. Col. John H. Jones, Deputy Director, 8th Marine Corps Reserve and Recruitment District; Lt. Hugh J. Leblanc, Communications Officer, 8th Coast Guard District; Father Frank Benedetto, Chairman, Physics Department, Loyola University of the South. and Brig. Gen. Francis A. Woofley, USA (Ret.).

New York

The initial fall meeting was held at the New York Naval Shipyard. Brooklyn, on September 18th. Prior to the start of the meeting, the members and guests were conducted through the Electronic Section of the Material Laboratories. They saw many of the elaborate and sensitive test equipments used

Louisiana—Head table at the August meeting held at the Naval Air Station. Left to right are: Lt. Col. John H. Jones, 8th Marine Corps Reserve & Recruitment District; Lt. Hugh J. LeBlanc, communications officer, 8th Coast Guard District; Fr. Frank Benedetto, Loyola University, chapter vice pres.; Col. W. J. Given, State Civil Defense, principal speaker; Brig. Gen. Francis A. Woofley, USA (Ret.); Chapter President Charles Pearson, Jr., Southern Bell; Fr. Carl Schutten, pastor, St. James Major Church; Col. James A. Moreau, State Selective Service; Dr. William P. Gardiner, New Orleans Board of Health; Bruce Hay, Southern Bell, chapter secretary.

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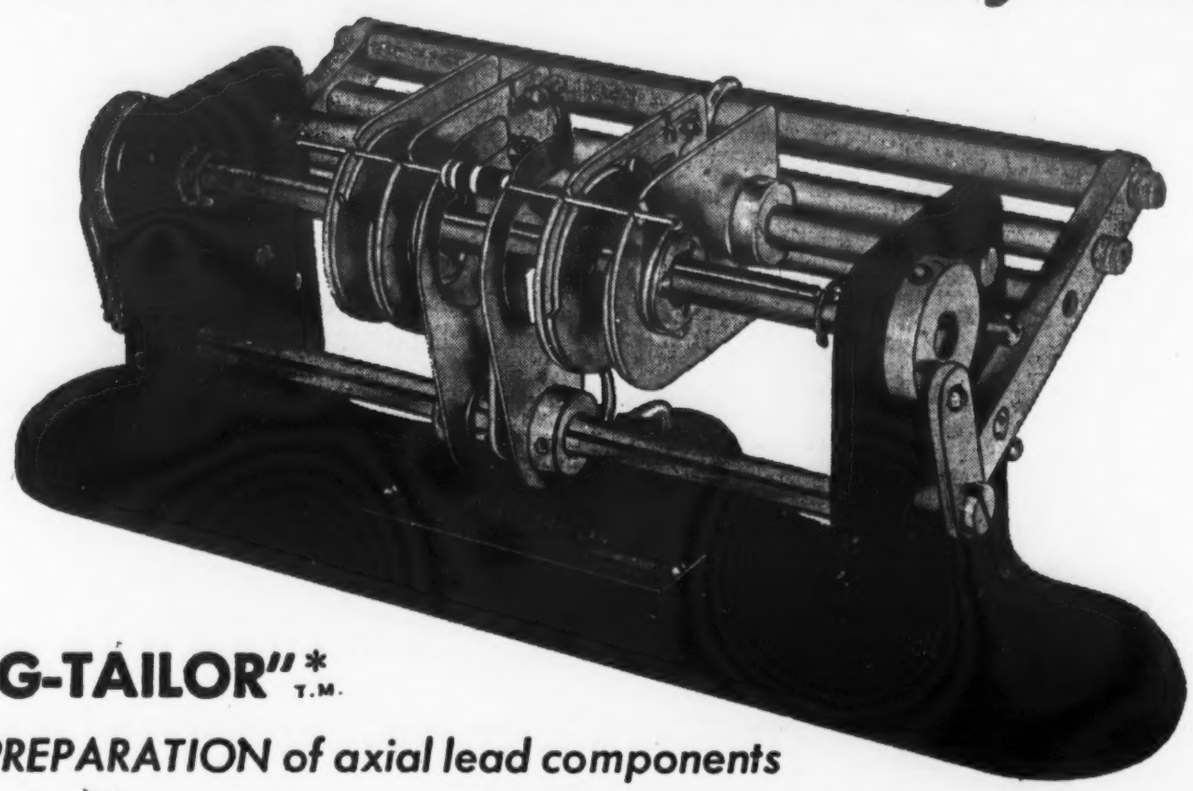

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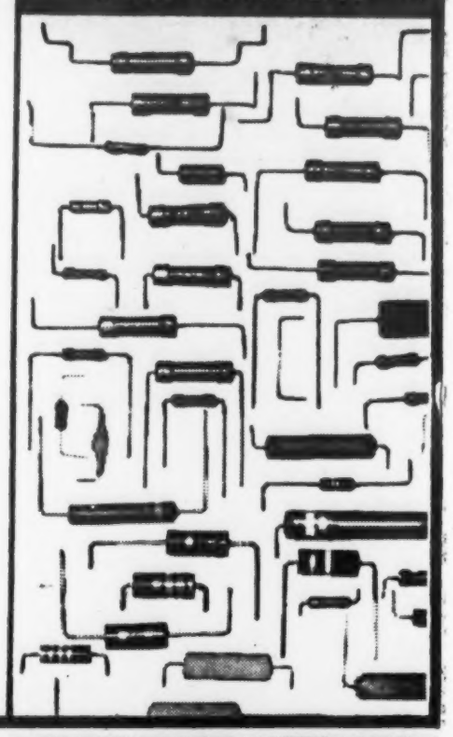

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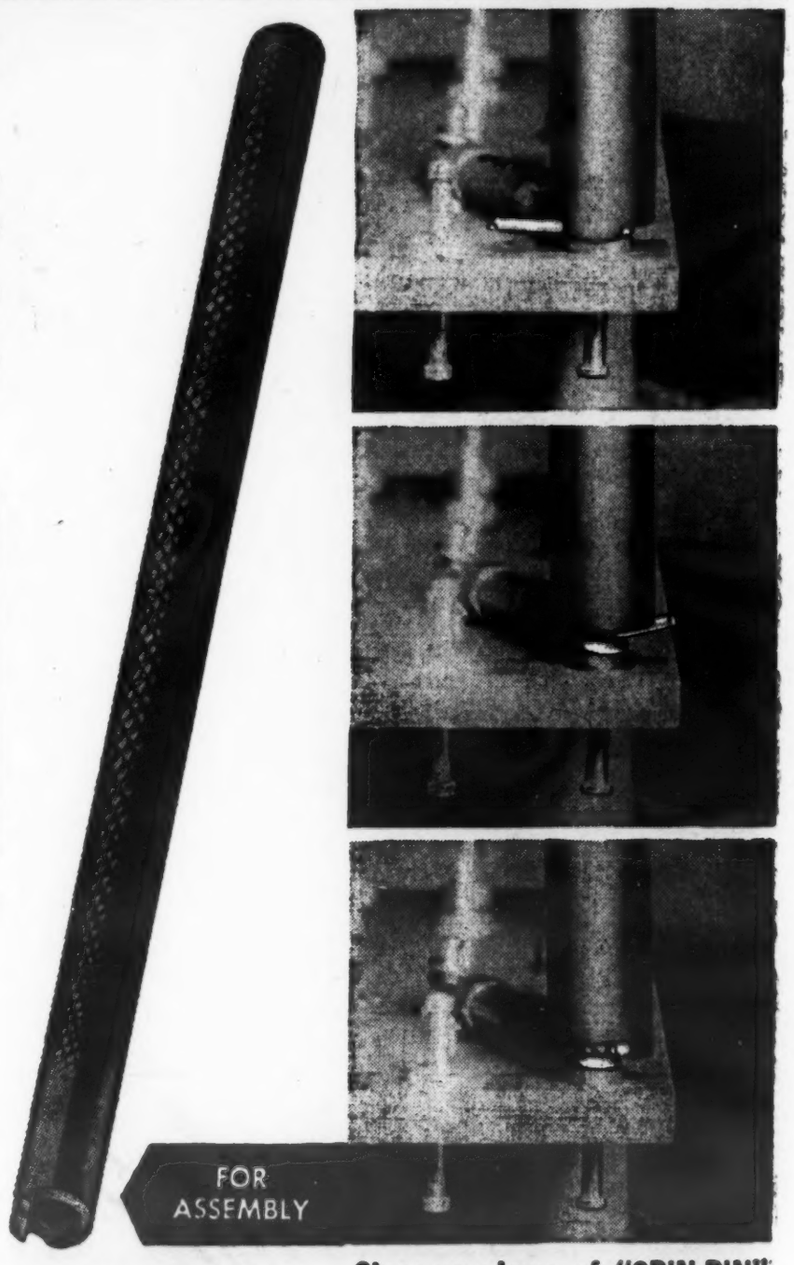
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

PIG-TAILORING eliminates:

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!



"SPIN-PIN"* T.M.

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-11P

BRUNO-NEW YORK INDUSTRIES CORPORATION

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET • NEW YORK 1, N. Y.

Northeastern University—Members of the student chapter are shown with Superintendent Albert L. O'Banion of the Boston Fire Department who explains the operation of an automatic fire alarm recording device. Looking on, left to right, are: Cadet 2nd Lt. Edward O'Keefe, Cadet 2nd Lt. Thomas King, Jr., Cadet 1st Lt. Wilfred Picard, Bill Regan, Cadet Capt. Joel Chase, and Maj. Fred J. Frank, chapter advisor.

by the Navy to test electronic components and other apparatus to verify that they meet specifications and reliability requirements.

The new aircraft carrier "Independence," presently under construction, was visited as well as the site of the new "Constellation" whose construction will be soon started.

Rear Admiral Leslie A. Kniskern, Commandant of the N.Y. Naval Shipyard, welcomed the chapter members at the dinner-meeting which started after the completion of the inspection tour.

Rear Admiral F. R. Furth, AFCEA national president, and other guests at the head table were introduced by chapter president Benjamin H. Oliver, Jr.

The guest speaker of the evening was Mr. R. J. Rhael of the Naval Material Laboratories who spoke on "Precision Navigation." He discussed the various factors which affect a ship's navigation system and the need of developing a precise navigation system that would be independent of weather, radio, magnetic influences, etc. Ballistic missiles require such systems of which inertial navigation is the heart.

Northeastern University

The following activities were scheduled for the September—November term of Division A:

Sept 11—orientation meeting, film: "Challenge of Outer Space;" Sept 13—special meeting for friends of AFCEA, movies and refreshments; Sept. 18—field trip to Fire Alarm Control Center; Sept 25—lecture-demonstration on Earth Satellite; Oct. 2—films: "Tale of Two Cities" (atomic bombing of Hiroshima and Nagasaki), and "Weapons of Artillery;" Oct. 9—helicopter flights and tour of Boston Harbor; Oct. 16—nominations for office, film: "This is Your Army;" Oct. 23—field trip to Station WBZ-TV; Oct. 30—elections, group discussions, plans for annual convention.

The chapter is already at work on its motion picture production for 1957-58. Ed O'Keefe and Tom King took movies of the presentation of the Cadet Brigade to Dr. Carl S. Ell, President of Northeastern, and the film was used by Station WBZ-TV on its news program.

A special brochure, issued to freshmen to acquaint them with the chapter's activities, has resulted in a good number of new AFCEA members at Northeastern.

Scott-St. Louis—A Western Union program featured the October 4th meeting. The group pictured above includes twelve Western Union representatives at the meeting. Seated, left to right: Col. William D. Cairnes, commander, 1405th Air Base Wing (MATS); Perry Norman, Dallas; George Trapp, Chicago; Paul H. Greer, New York, principal speaker; Robert F. Dierkes, New York; Col. Charles W. Gordon, chapter president; Harry E. Vermillion, St. Louis. Standing, left to right: Dwight E. Morga, Thurston P. Anderson, G. P. Short, James G. Blain, W. J. Abram, T. Lew Moore and Jay R. Riggs, all from St. Louis.

Philadelphia

Chapter officers elected to serve for the 1957-58 term are:

President—J. B. Henry, International Resistance Company. Vice presidents—Colonel E. L. Littell, USA (USASSA); Captain H. W. Englund, USN; R. G. Wickes, Wickes Engineering & Construction Co.; F. O. Ziegler, Radio Corporation of America; F. D. Langstroth, Philco Corporation. Secretary—R. L. Halberstadt, The Bell Telephone Company of Pennsylvania. Treasurer—T. H. Armstrong, Radio Condenser Company.

South Carolina—"Earth Satellite for Geophysical Studies" was the subject of a Bendix Radio Presentation at the September 19th meeting held at Shaw Air Force Base. Shown, left to right, are: Brig. Gen. Stephen B. Mack, Commander of Shaw Air Force Base, host for the meeting; Cdr. Harry C. Rodin, USN, chapter president, and Ernest A. Duquet of Bendix Radio who conducted the program.

Rome-Utica

The chapter's September 18th meeting was reported in the Rome Daily Sentinel as follows:

" 'Old Days of Radio' was the subject of Harry Sadenwater, Radio Engineering Laboratories, Inc., who spoke last night before the Rome-Utica chapter of the Armed Forces Communications and Electronics Association.

"Meetings at the Griffis AFB Officers Club, the group heard Sadenwater discuss radio highlights, beginning with 1908 when, as an amateur, he was thrilled to transmit a message and then walk to the receiving station a mile away to see if the message had been received.

CHAPTER NEWS

"Mr. Sadenwater was one of 105 members of the Institute of Radio Engineers when it was formed in 1912. The IRE now has more than 40,000 members.

"In 1915 Sadenwater and Maj. Gen. David Sarnoff, now of RCA, were wireless inspectors. Sadenwater pointed out the importance of communications even in those days of experimentation. At that time they, as inspectors, would not permit a ship to sail until satisfactory communication was established. If a ship sailed without satisfactory communication, the captain would be fined $5,000.

"A major step in wireless communications was accomplished in 1916, he said, when John F. Grinan, a sugar planter of Jamaica and at that time a radio inspector, sent and received a coast-to-coast message in 24 hours.

"The year 1919 saw the forerunner of the first aircraft navigation wireless flight across the Atlantic, Sadenwater related. He was in one of three Navy planes which took off from Rockway Beach Naval Air Station, N. Y., for Plymouth, England.

"To aid with navigation, receive advance weather reports and assist if necessary with 61 destroyers, five battleships, four supply ships and four seaplane tenders spaced at 50-mile intervals. One of the three planes completed the trip. Sadenwater's plane sank off the Azores.

"For his participation in the advancement of aircraft wireless navigation across the Atlantic, he was awarded the Navy Cross and the Order of the Tower and Sword. Sadenwater has been with Radio Engineering Laboratories since 1947, working with some of the first tropospheric scatter developments."

San Francisco

The chapter's annual Ladies' Night meeting, held on September 27th at the Fort Mason Officers Club, enjoyed its traditional success.

The evening was devoted to a social hour, steak or seafood dinner, and dancing into the late hours.

Scott-St. Louis

The U.S. Naval Air Station in St. Louis was host to the chapter for its first meeting of the fall on September 6th. Members and guests were welcomed to the Station by Commander Thornton on behalf of Capt. Clayton L. Miller, the commanding officer.

The program commenced with a conducted tour of the facilities of the Station and those of the tenant CAA Control Tower. This was followed by a social hour and dinner at the BOQ.

Principal speaker of the evening was Rear Admiral Joseph N. Wenger, USN, Deputy Director for Communications-Electronics, Joint Staff, whose subject was the importance of teamwork—within the Services and between the Services and industry—in the fields of communications and electronics.

On October 4th, the chapter met at

Augustine's in Belleville and heard Paul H. Greer, Assistant Director for Private Wire Service and Facsimile, Western Union Telegraph Company, New York, discussed "Facsimilie, Today and Tomorrow."

Mr. Greer's talk, supplemented with slides, concerned both military and industrial applications and installations of facsimile equipment. In addition, he reviewed the history of facsimile, its speed and degree of advancement to the present day, and the forecast of expectations for its future.

Harry E. Vermillion, Operating Superintendent, Western Union, St. Louis, introduced Mr. Greer to the group. Other Western Union representatives were guests of the chapter as follows: Robert F. Dierkes, New York; Perry Norman, Dallas, and George Trapp, Chicago.

South Carolina

The chapter held its first meeting of the 1957-58 year at Shaw Air Force Base on September 19th, with over 125 in attendance.

The program, "Earth Satellite for Geophysical Studies," was presented by Ernest A. Duquet of Bendix Radio Division of Bendix Aviation Corporation. Mr. Duquet described the satellite in flight from its launching to its self-destruction. He also discussed Minitrack, the radio tracking system for which Bendix produces the ground receiving components.

Brigadier General Stephen B. Mack, Commander of Shaw Air Force Base, was host for the meeting. Commander Harry C. Rodin of the Charleston Naval Shipyard, who is president of the chapter. arranged the program.

The Charleston subsection of the IRE met with the chapter.

South Texas

The chapter opened the fall season with a dinner-meeting at Randolph Field Officers Club on October 3rd. Some one hundred members and guests were present.

"High Fidelity" was the subject of a program presented by the Southwest Radio and Sound Equipment Company. Representatives of the company explained the high fidelity sound system and described the components required to make up a hi-fi set.

Highlight of the program was a demonstration of stereophonic sound, the newest development in the audio world.

Southern California—Chapter officials are shown with James M. Bridges, Director of Electronics, Office of the Assistant Secretary of Defense, who addressed a recent meeting in Los Angeles. Left to right: Richard Fuller, Bendix-Pacific, director; Lester R. Daniels, Daniels Engineering, Inc., president; Mr. Bridges; C. A. LaHar, RCA, director; and Rear Adm. Charles F. Horne, Convair, director.

Southern California

James M. Bridges, Director of Electronics, Office of the Assistant Secretary of Defense (Research and Engineering), addressed the chapter at its dinner-meeting in Los Angeles on June 25th.

In his talk, Mr. Bridges stressed the significant technical manpower shortage which has been developing in our Nation during the past decade. As a means to interpret properly the technical manpower problem, Mr. Bridges outlined the effect of the present period of technological, economic and political revolution which has drastically increased the demand for scientists and engineers and altered the basic processes and procedures of engineering management.

To every company having major contracts for developing equipment or weapon systems, he said: "Make an objective and critical self-appraisal of the management of at least one of your programs, including a detailed analysis of the accountability of all engineering effort expended on the project in your own plants and in those of your subcontractors. The results of such a survey would be of great value to high-level industrial management, particularly in revealing areas where the utilization of technical manpower could be made more effective, and our Committee on Technical Manpower Utilization would certainly welcome information of this kind from a broad cross section of industrial concerns."

Washington—At the October 1st meeting, which featured a Navy program on "Sea Power in the Nuclear-Missile Age," are left to right: L. Harriss Robinson of Motorola, chapter president; Rear Adm. F. R. Furth, IT&T, National AFCEA President; Maj. Gen. James D. O'Connell, Chief Signal Officer and National AFCEA Vice President, and Capt. Wilfred B. Goulett, AFCEA Executive Vice President.

Washington

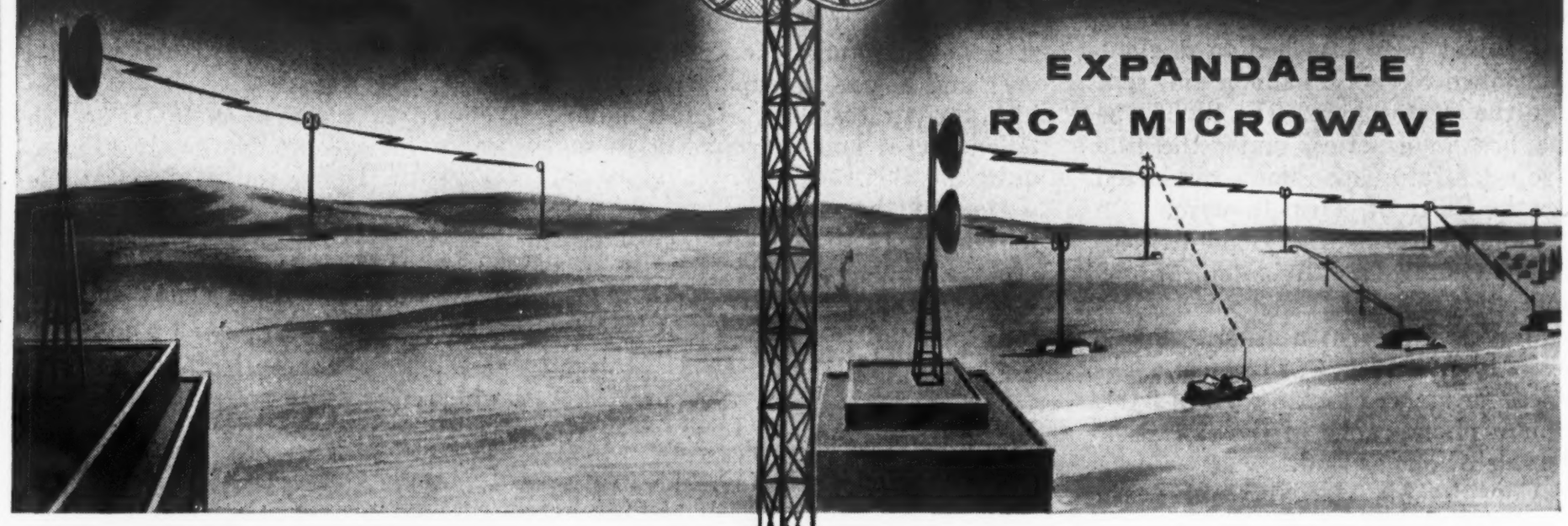
Sea power in the nuclear-missile age was the subject of a discussion by Captain Henry L. Miller, Office Chief of Naval Operation, Department of Navy. at the first fall meeting of the Washington Chapter on October 1st.

Speaking to a group of nearly 500 members at the Willard Hotel, Captain Miller and a crack Navy presentation team gave a dramatic projection of the Navy's capabilities in maintaining lines of sea communication. Also discussed was the Soviet war machine, and the growing menace of the Soviet Navy to freedom of the sea.

First fall meeting of the chapter was convened by L. Harriss Robinson (Motorola) as new president. With him at the head table were Colonel Percy G. Black (Automatic Electric Company), past AFCEA National President; Millard C. Richmond (Western Electric), new AFCEA National Treasurer; Captain Wilfred B. Goulett (USN Ret.), new AFCEA National Executive Vice President; Major General J. D. O'Connell (Chief Signal Officer), National AFCEA Vice President; Rear Admiral F. R. Furth (International Telephone & Telegraph Corporation), AFCEA National President; Captain Marshall H. Austin (Office, Chief of Naval Operations, USN); Captain C. M. MacDonald (Office, Chief of Bureau of Ordnance, USN); Rear Admiral William A. Schoech (Deputy and Assistant Chief, Bureau of Aeronautics, USN); Captain Jack Dorsey (Office, Chief of Naval Operations, USN), Vice President of Washington Chapter, and Captain Henry L. Miller, USN (Office, Chief of Naval Operations), who presented the program.

Admiral Furth officially introduced Captain Goulett to the group.

The Microwave Radio System *that Grows... as you Grow!*



RCA Microwave Radio Systems are designed with future needs in mind. They do not face obsolescence because of users' growth. High channel capacity permits orderly growth up to a total of 120 channels for voice, data transmission, supervisory control and other purposes.

RCA was one of the earliest pioneers in the development of microwave for commercial communications. Today, RCA Microwave Systems provide users throughout the world with many important features . . . operation in the most advantageous frequency bands, simplified installation and minimum maintenance cost.

Serving their users with dependability and precision, RCA Microwave Systems are now operated by utilities, gas and petroleum pipelines, cross country turnpikes, and government agencies.

More than a million channel miles of RCA Microwave Systems in service . . . performance proved throughout the world.

RCA Microwave specialists will be glad to answer any questions and help plan your installation. Mail coupon for further particulars.

SPECIAL NOTE TO RCA CUSTOMERS:

Ask about the RCA "Package Expansion Plan" which confirms your wise choice of RCA CW-20 or MM-26 Microwave for your communications system. A minor field modification will bring your system up to 48, 72 or even 96 channel capacity, depending on your revised requirements.

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ITEMS OF INTEREST

From Government, Industry and the Services

Sharp Sun Spots

The sharpest photographs ever taken of the sun were secured recently by a unique telescope-camera which had been attached to a giant unmanned Skyhook balloon and sent into the stratosphere. The flight was the first in a series, under the title Project Stratoscope, being conducted for the Office of Naval Research.

Launched from the General Mills Flight Center, New Brighton, Minnesota, the balloon hovered for 3 hours and 45 minutes at a predetermined altitude of about 81,000 feet. The telescope-camera took a total of 8,000 35mm photographs of the sun at intervals of one second.

Considerable time is said to be needed for astronomers and other scientists to evaluate properly the knowledge gained from these photographs, but it is expected that the pictures will greatly broaden man's knowledge of the smaller turbulent sun-eddies, the local hot gas storms, solar flares, and ultimately, perhaps, long-distance radio disturbances.

Ramjet Sets Records

Three new speed records were set recently by a Lockheed X-7 ramjet missile as it completed its 10th successful flight. The event also was a record for any single U. S. supersonic missile.

The X-7, dubbed "Methuselah," marked up the following faster-than-sound records: Fastest speed for (1) any ramjet powered missile (2) any ground controlled missile and (3) any recoverable missile.

According to Lockheed technicians, the supersonic speed run resulted in paint burned black by the blazing air friction heat.

The Air Force reports that due to the fact that the Lockheed X-7 is recovered by parachute and flown again, each reflight saves taxpayers $350,000 in missile research costs. The "Methuselah," with its 10-flight record, reportedly has already "banked $3.5 million in missile expenditures."

This particular X-7 has successfully flown an average of almost once a month since its first air launch last summer and has never been returned for repairs.

Out of sight during most of its flight, it is piloted by earthbound engineers and radios performance data back to technicians as it maneuvers to fully test ramjet engines.

Launched from a B-29 mother ship at a high altitude, the ramjet takes over and begins its supersonic climb into the stratosphere after a flame tailed rocket booster zooms it to required speeds.

One of the nation's first missile developments, the Lockheed craft was created more than a decade ago under Air Force contracts.

"Flat Plate" Tube

A transparent "flat plate" cathode ray tube has been designed which "will definitely help to make instrument flying as simple as flying in good, clear weather."

The tube, which an airplane pilot can either look at or through without shifting his reference, according to weather conditions, was described at the 82nd semiannual convention of the Society of Motion Picture and Television Engineers.

The new visual aid to aviation, which the Navy has dubbed the "Buck Rogers viewing screen," is designed for installation in the area of an airplane windshield. It permits the pilot to view at will, either the flight data displayed on the tube or the actual air space visible beyond the transparent screen.

Establishment of the need and requirements for the tube, its physical aspects, and the development of the transparent phosphors used on the screen were described in three separate papers by Commander George W. Hoover, of the Office of Naval Research; Ross Aiken, of Kaiser Aircraft and Electronics, who developed the tube, and Dr. Charles Feldman, of the Naval Research Laboratory.

New Fuel Cell

With the development of the first fuel cell capable of economically producing thousands of watts of power, direct conversion of the chemical energy of gases into electricity has been accomplished.

First significant military application of the cells, which use hydrogen and oxygen as fuel, is in providing silent electrical power for the U. S. Army Signal Corps' "Silent Sentry" radar. The "Silent Sentry," which is the world's smallest known radar set, is a lightweight, portable unit that provides mobile Army forces with local combat surveillance of enemy movements despite smoke, darkness or fog.

The new source of power was developed by scientists at the Research Laboratories of National Carbon Company, Division of Union Carbide Corporation.

"Secret of the new fuel cell's success," Dr. C. E. Larson, National Carbon's research vice president, said, "is the chemically treated, hollow, porous carbon electrodes through which the gases enter the cell, and which also conduct the electricity produced by the electrochemical reaction."

"Manned Satellite"

A design for a "manned satellite," which within eight years could become the nucleus for an economically feasible space station, has been developed by Goodyear Aircraft Corp., Akron, Ohio.

According to a Goodyear scientist, the proposed manned satellite would attain a speed of 16,660 miles an hour while cruising in an orbit 500 miles above the earth. Technically described as a "manned earth satellite terminal evolving from earth-to-orbit ferry rockets," it has been dubbed "Meteor Junior." The "Junior" refers to the fact that the new project is a modification of an earlier and larger version talked of in 1954 and identified as "Meteor."

The scientists further reported that the satellite also could be adapted for use in "near-by" space explorations, including trips to the moon.

Details of the vehicle were reported in a paper prepared for a meeting of the International Astronautical Federation in Barcelona, Spain.

USC Receives Computer

The University of Southern California has received an electronic digital computer which will be an aid to new research in measuring man's intelligence. According to reports, this may lead to a comprehensive theory about the intellectual processes of man, with special emphasis on creativity.

(*Continued on page* 68)

ITEMS OF INTEREST

The computer was presented to the University by the National Cash Register Company, Electronics Division of Hawthorne, Calif. Complete with an auxiliary tape memory unit and input-output equipment, the system is installed in special new facilities in the school's engineering building.

The project is being conducted for the Office of Naval Research by Dr. J. Paul Guilford, SC professor of psychology, with Philip R. Merrifield as assistant director.

The old, standard IQ test, with its single score, was far from an adequate yardstick of adult intelligence, according to Dr. Guilford. His new system, based on about 45 established factors of intellect, provides a "many-sided" picture of intelligence; one of the implications of the system is that there may be as many as 75 intellectual factors in which individuals may differ.

The NCR electronic computer system, by reducing the time needed to analyze test scores, will make it possible to obtain results much more quickly, even from large groups of people.

As data from many tests are fed into the computer, intercorrelated results emerge immediately on punched paper tape. The tape in turn operates an automatic typewriter which rapidly prints the results in tabular form.

In addition to making computations in engineering and the physical sciences, the computer will play an important part in other fields of research.

Air Navigation System

Stavid Engineering, Inc., Plainfield, N. J., has a new air navigation system which proposes a solution to the mid-air collision threat.

According to the company's president, David F. Sanders, the system, called Radio Web, "offers the most promise for the interim period and for the foreseeable future in the handling of increasing traffic loads." It is said to be the only method capable of solving with ease all three common system requirements, i.e., air navigation, traffic pattern control and air collision warning for both short and long range (50 miles) conditions.

Radio Web will consist of modular airborne units to provide all types of aircraft with one or more of the following information-sources: heading and distance to destination; a continuous graphic display of position, track and ground speed; a relative position indicator (with collision warning) plus other refinements for large aircraft to establish voice communication with the ground, altitude control and a data link for ground control.

Deriving its name from a web or grid network generated by transmitting towers spaced approximately 600 miles apart across the U.S., the system contains radio signals which sweep the area between any 4 towers to provide aircraft with a position fix.

"Radar Remembrance"

Special "radar remembrance" techniques were reported by two Texas A & M College scientists, Myron G. H. Ligda and James Sullivan, at the recent 1957 Conference of the Society of Photographic Scientists and Engineers in Asbury Park, N. J.

The radarscope operation makes possible the detection of transient echoes from lightning discharges, flash-flood-producing storms and even the horizontal distribution of rain in different layers of the atmosphere.

The techniques include such diverse and unusual procedures as high-speed continuous strip photography, image addition and subtraction and color photography, along with time lapse, time exposure and rapid process photography. All of these, Ligda and Sullivan report, have been employed effectively in radar meteorology.

High Speed Films, Dry Process

An Army general, speaking before the 1957 Annual Conference of the Society of Photographic Scientists and Engineers, cited, as military needs, the development of high speed films and a completely dry photographic process.

Brig. Gen. Earle F. Cook, commanding officer, Army Signal Engineering Laboratories, Fort Monmouth, N. J., told the scientists that photography is the most advanced sensory technique available to the military for gathering intelligence information in combat surveillance.

While the Signal Corps is currently sponsoring development of more advanced equipment for use on the ground and in the air, General Cook said, there are several long range objectives beyond the current program of research. He listed four of these:

(1) A completely dry photographic process with capabilities for taking and reproducing photographic information in much shorter time than now possible.

(2) A photographic sensing material that is sufficiently sensitive in the visible spectrum and at the same time of negligible sensitivity to nuclear radiation.

(3) A high speed photographic film or sensor which will permit photography under very low-level illumination such as passive night photography. This may also require concurrent development in optics and processing fields to evolve an overall compatible system, the General pointed out.

(4) A satisfactory technique and equipment for the automatic and timely extraction and processing of essential information from the thousands of photographs required in a military operation.

Launching Test Program

The Department of Defense has announced some details of the test program leading up to the launching of a scientific earth satellite during the International Geophysical Year.

The U. S. IGY scientific program is under the over-all direction of the IGY Committee of the National Academy of Sciences. Launching vehicle tests are being conducted by the Naval Research Laboratory at Patrick Air Force Base, Cape Canaveral, Florida. These tests are designed to allow orderly evolution from a single-stage rocket to the three stage launching vehicle required for placing a scientific earth satellite on orbit to gather upper atmosphere scientific data.

To date there have been two test vehicle launchings, both of which have been highly successful. The first, on December 8, 1956, was a single-stage rocket using a Martin Viking. The second, on May 1, 1957, was a two-part rocket

Cable System Ceremony

The world's longest and deepest undersea telephone cable system, linking the Mainland with Hawaii, was opened to public service October 8 following an exchange of greetings among dignitaries at Washington, San Francisco and Honolulu. The event introduced a new feature to overseas telephony . . . operator dialing.

Frederick R. Kappel, President of A.T.&T., acted as master of ceremonies for the proceedings which were held in the Executive Office Building in Washington. Other participants in the Capital were secretary of Defense Charles E. Wilson; Postmaster General Arthur E. Summerfield; Gen-

ITEMS OF INTEREST

eral Nathan F. Twining, USAF, Chairman of the Joint Chiefs of Staff; John C. Doerfer, Chairman of the Federal Communications Commission, and Henry T. Killingsworth, Vice President of A.T.&T., in charge of its Long Lines Department.

At 4:00 P.M. (EDT), inaugural conversations began. These included one which extended from Washington to London, back to Ketchikan, Alaska, via New York and Seattle, and on to Honolulu. This call was 18,000 miles in length and utilized all three deep-sea cables placed by A.T.&T. during the past year—the transatlantic, the Alaskan and the new one to Hawaii. The ceremony lasted 40 minutes, then the Pacific cable system was opened for commercial use.

On completion of the impressive ceremony, many of those present, including the new Executive Vice President of AFCEA, Captain W. B. Goulett, USN (ret.), enjoyed the privilege of talking over the Hawaiian cable to Honolulu.

R.I.T.C. Anniversary

The Radio Interference Technical Committee of Los Angeles recently celebrated its first anniversary. The membership roster includes over 109 engineers from major aircraft and component manufacturing companies, military establishments, testing labs, etc. Its members are employed throughout the United States as specialists in radio interference suppression.

The voluntary group was formed primarily as a result of military concern over the increasing problems of radio interference in communication and guidance systems. The aim of the group is to advance the science of radio interference control through education and exchange of technical information.

Vast increase in radio-electronic activity today has brought complex problems of noise interference in spheres ranging from aircraft communications and transmission for guided missile navigation, to private television sets. (See page 72.)

Names In The News

John R. Townsend, of the Sandia Corp., has been named as Special Assistant to the Assistant Secretary of Defense for Research and Engineering. He also will serve as the Director of the Office of Fuels, Materials and Ordnance.

Charles P. Ginsburg, manager of Advanced Videotape Development, Ampex Corporation, received the David Sarnoff Gold Medal Award for his achievements in the development of a practical video recorder. The presentation was made at the recent 82nd Semi-Annual Convention of the Society of Motion Picture & Television Engineers.

Frederick R. Furth, president of AFCEA, has been appointed Director of Research and Engineering for IT&T. He succeeds **Harold H. Buttner**, who will continue as Vice President and Technical Consultant.

Richard J. Meyer's promotion to the rank of Brigadier General was announced recently by the Department of the Army. General Meyer is Chief of the Research and Development Division, Office of the Chief Signal Officer in Washington, D. C.

Charles S. Rockwell has been named President and General Manager of the Ford Instrument Company, Division of Sperry Rand Corporation. Mr. Rockwell assumed the post upon the retirement of **Raymond F. Jahn**. In addition, he will serve as president of Sperry Farragut Co. Division of Sperry Rand, a post Mr. Jahn also held.

Brigadier General J. Harry LaBrum was honored with a garrison review at Fort Monmouth, N. J., upon his retirement from Reserve service. A member of a Philadelphia law firm, General LaBrum was released from active duty in 1945.

Sir Robert A. Watson-Watt, Radio-physicist of Toronto, Ontario, Canada, was the recipient of the Elliott Cresson Medal of The Franklin Institute. Sir Robert, a distant kinsman of James Watt, father of the steam engine, is being cited "for his conception of pulsed radar for the vital air defense of Great Britain, for his solutions of important technical problems, and for his inspiring leadership which resulted in the timely development of these radar systems."

Albert W. Hull and **Dr. W. R. G. Baker** have received the 1958 Institute of Radio Engineers awards. Dr. Hull, consultant to the General Electric Research Laboratory, is credited with creating more new types of electron tubes than anyone else. Dr. Baker, GE vice-president, was cited for "outstanding contributions" in communications and electronics.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc., required by the act of Congress of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946, of SIGNAL Magazine, published monthly at Washington, D. C. (additional entry, Baltimore) for October 1957.

District of Columbia } ss.
City of Washington }

Before me, a notary public, in and for the State and County aforesaid, personally appeared W. J. Baird, who, having been duly sworn according to law, deposes and says that he is the Editor of the SIGNAL Magazine and that the following is, to the best of his knowledge and belief, a true statement of the ownership and management of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946, to wit:

1. That the names and addresses of the publisher, editor, managing editor are:

Publisher: Armed Forces Communications and Electronics Association, 1624 Eye St., N. W., Washington 6, D. C.

Editor: W. J. Baird, same address.

Managing Editor: Judith H. Shreve, same address.

2. That the owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.

Armed Forces Communications and Electronics Association, 1624 Eye Street, N. W., Washington 6, D. C.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

None.

4. That paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also that the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

W. J. BAIRD,
Editor.

Sworn to and subscribed before me this 3rd day of October, 1957.

(Seal) HAZEL JANE DAVIES,
Notary Public.

(My commission expires June 30, 1960.)

PERSONNEL CLEARING HOUSE

AFCEA Members Available to Industry

The pages of SIGNAL are open to active AFCEA members who are seeking positions in the communications, electronics and photographic industries. Any member is entitled to space free of charge in this column for three issues of the magazine. Please limit your notice to five lines. In replying, employers are asked to address: Box ——, SIGNAL, 1624 Eye Street, N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

MANUFACTURERS REPRESENTATIVE with over sixteen years experience, partly as a USAF employee, in negotiating and liaison engineering of contracts with the USAF at Wright Field and Gentile AF Depot has time available for additional companies desiring or doing Air Force business. Box 127.

GOVT. PROCUREMENT AND ADMINISTRATIVE CONSULTANT. Wide background and experience includes practice in taxes, accountant with Attorney General of New York and Congressional Committee. Worked with U. S. Dept. of Defense in formulating ASPR, dealing with termination, renegotiation and contract administration. Box 128.

REPRESENTATIVE with a wide following among manufacturers of electronic equipment and government agencies on the Eastern seaboard has an opening for an additional line of quality components. Straight commission basis. Box 129.

FIELD ENGINEER OR MANUFACTURERS LIAISON REPRESENTATIVE: Retired CWO experienced in radar, closed circuit TV. b&w and color and Kinescope recording, data processing and automation, and R & D work. Will relocate with family only. Box 130.

WORKS MANAGER OR CHIEF ENGINEER. Record of managerial competence in integrating engineering, sales and manufacturing. Broad technical background covering several engineering fields such as missile ground support equipment and instruments, solid related manufacturing experience, top sales contacts for military R & D and production work. Box 131.

ELECTRONICS TECHNICAL WRITER AND ADMINISTRATOR: Retired Navy CWO, W-4, Electronic Technician, with 22 years of wide, varied experience in the field of electronics. Prefer Florida or Baltimore-Washington area. Box 132.

Positions Available

Industry, government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.

ELECTRONIC ENGINEERS (up to $7570 per year) are needed by the Civil Aeronautics Administration to apply latest knowledge of electronics to air traffic control, telecommunications and navigational aids. Individual engineer positions concerned with the design, procurement and specifications, factory inspection, installation, calibration and maintenance of ground and airborne electronic equipment. Equipment includes radar, distance aids, VHF radio transmitters and receivers and radio and land line telecommunications. Employee benefits: paid vacations, sick leave, insurance and retirement programs. Write Civil Aeronautics Administration, Personnel Division (W-91.3), T-5 Bldg., 17th & Constitution Ave., N. W., Washington 25, D. C.

SCENARIO WRITER ($7570 per year). Six years of progressively responsible and successful experience in writing scenarios, script, dialogue for motion pictures or related fields. Experience must include three years in field or motion pictures. Substitution of education for experience: successful completion of study in college or university may be substituted for not more than 3 years of the required experience on the basis of one year of education for each 9 months of experience. No educational substitution will be allowed for experience in the field of motion pictures. Grade GS-1071-12. Army Pictorial Center, Long Island City 1, N. Y.

TELETYPE OPERATORS, COASTAL STATION RADIO OPERATORS. International communications company. Liberal company benefits. Submit resume with name, address, age, past experience—if any, military experience—if any, FCC Second Class Radiotelegraph license required for Coastal Station Radio Operator. Write to Asst. Director of Personnel, RCA Communications, Inc., 66 Broad Street, New York 4, N. Y.

PACKAGING AND PRESERVATION SPECIALISTS GS-7 and 9 ($4525 to $6250 per year) are needed by the Philadelphia U.S. Army Signal Supply Agency to develop and write specifications for preservation, packaging, packing and marking of Signal Corps equipment. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

Editor's note: In view of the importance of the development and the interest generated, a more detailed account concerning "solion" is presented here. The August issue of SIGNAL *carried a short item on the subject.*

"SOLION" . . . IONS IN SOLUTION

Scientists are making it tougher all the time for electronic engineers.

First, it was the transistor, and the engineer had to learn about solid-state physics. Next, it was the magnetic amplifier and ferritic devices, and the engineer had to brush up on magnetism.

Now, scientists at the U. S. Naval Ordnance Laboratory, at White Oak, Maryland, have come up with "Chemtronics"—a combination of electrochemistry and electronics. Their first device in this new field is the "solion" — pronounced so' — lee — on, and short for ions in solution. It was developed in cooperation with the Defense Research Laboratory of the University of Texas, and the Emhart Manufacturing Company of Hartford, Connecticut.

The new device utilizes ions moving in a chemical solution, rather than electrons moving through a gas or a vacuum as in an electron tube, or through a solid as in a transistor. Physically, the solion consists of a plastic cylinder, perhaps pocket-watch in size, containing a potassium iodide solution in which two or more electrodes are immersed. Polarization is by means of a nine-tenths volt battery. Changes in temperature, pressure, light, sound, or acceleration will stimulate and vary the flow of ions and hence the current output. The device is reversible.

The principal advantage of these new devices is their very low power consumption, much less, in certain applications, than comparable transistor systems. Inherent stability, long life, ease of manufacture and simplicity of operation are other advantages, together with low cost—once fabrication is put on a mass production basis.

Potential applications for solions include:

(1) Rate circuits of all descriptions, whether operated from temperature, pressure, or electrical, etc., sources;

(2) Integration units requiring continuous read-out of high precision —apparently of sufficient accuracy for acceleration (inertial) guidance systems and small visual exposure meters for personnel projection around jet aircraft engines (similar to film dosimeters for radiation protection of personnel);

(3) Detection and measurement of acoustic signals of low frequency (below about 400 cps at present) and accelerations;

(4) Product circuits involving either electrical derivative or hydraulic flow, or both;

(5) Electrical and small signal hydraulic amplifiers;

(6) Computer circuits;

(7) Amplifiers.

NEW PRODUCTS FROM INDUSTRY

Triple-Track Tape

Designed to give the utmost in high fidelity stereophonic sound, a new triple-track tape recording system developed by the RCA-Victor Division of Radio Corporation of America was recently demonstrated by the Chicago Symphony Orchestra.

The technique uses three separate sound tracks on a ½" recording tape, each of which is picked up from a separate microphone. The 3 separate recordings are fed to loudspeakers located in the same general position as the microphones, thus giving a 3-dimensional effect to the music.

7-Band 9-Transistor Short-Wave Radio

Covering the six most frequently used short-wave bands as well as the standard broadcast band, a fully transistorized short-wave radio which operates on ordinary flash-light batteries is now available from Philco Corp. of Phila., Penn.

Called the T-9 "Trans-World" portable, the set weighs less than 20 lbs. and measures 16 x 11 x 7 inches. Use of "surface barrier" transistors serves to bring in weak short-wave signals, permitting the signal to be magnified over ten million correct times, it is said.

Station selectivity power ratio is claimed to be 100 times greater than that of conventional standard broadcast receivers. Other exclusive features include flywheel tuning, moisture-proof wiring circuit and a logging scale attached to the band selector for easy band identification.

Sub-Miniature TV Camera Chain

Ideal for airborne and other military installations where observation personnel is impractical, a new vidicon TV camera chain, incorporating sub-miniature components designed to meet military specifications, is now available from Allen B. Du Mont Laboratories, Inc., Clifton, New Jersey.

Compact and lightweight (camera head measures 5 x 4 x 7 13/16 inches), the system offers a resolution of 100% modulation at 600 lines and is capable of reproducing the ten shades of gray on the EIA test chart, in addition to a sweep non-linearity rated at 2% maximum for each sweep unit.

Automatic Fine Tuning For TV

Standard Coil Products Co., Inc., 2085 No. Hawthorne, Melrose Park, Illinois, has developed 2 radically different TV circuit designs, either one of which may be incorporated into their new "Neutrode" turret tuner which features automatic, fine tuning together with automatically locked-in picture immediately after the TV set is turned on. In addition, no dial adjustment is necessary when a channel change is effected.

This new stabilized oscillator tuner, with its special high capacitance circuitry, stops the oscillator "drift" and holds its signal steady at the desired frequency.

Of turret construction, the tuner utilizes printed circuitry with provision for reception of a total of 82 VHF-UHF channels by the use of snap-in strips. Each tuner accommodates 13 such strips.

Canadian Press Wireless

A "completely new concept of a printing telegraph system," which is portable, weighs some 30 lbs. and is comparatively small in size, being easily carried, was announced last week by Press Wireless, Inc., after a demonstration of the unit in PREWI's New York offices by the carrier and Jayflex, Ltd., Montreal, Canada.

Said to be extremely quiet in operation, the machine will operate on any speed between 60 and 100 wpm with merely a change of the belt pulley; contains automatic switching facilities for 64 or more circuits and automatic answer-back with no paper disablement control; and is equipped with a back-space arrangement to permit correcting or obliterating a character already typed.

By the use of sequential selector arrangements, a single machine will function as an automatic telegraph switchboard for routing messages.

"1000 Series" Potentiometers

Announced by the newly organized Components Division of Chicago Aerial Industries, Inc., to be located at Franklin Park, Ill., is a new line of ultra-precision potentiometers, ranging in size from ⅞" to 3" and said to offer exceptional operation characteristics.

New Synthetic Adhesive

A method which firmly bonds polyethylene plastic to rubber, brass or brass-plated metals has been developed by the Bell Telephone Laboratories of Whippany, N. J.

The new technique is based on a synthetic adhesive known as "partly hydrogenated polybutadiene," said to be so strong that it will resist a pull of about 1,000 pounds per sq. inch, or many times the strength of the best present bonding agents.

Automatic Dial Mobile Radiotelephone Unit

General Electric Co. of Syracuse, N. Y., recently announced a new commercial unit for use in automobiles, boats, and other mobile equipment, to provide 2-way radio communication, without manual operator handling, between vehicles and wired telephone instruments, or between 2 of the mobile units.

Key to the new unit is a "secode" selective control device, used along with standard GE mobile radio equipment.

The "secode" device can further be used to control traffic lights, start and stop machinery, turn lights and electric signs on and off, and actuate almost any kind of electrically controlled device keyed to a radiotelephone unit while the vehicle is parked or moving.

Two Advanced Type Transistors

Together with the new germanium p-n-p alloy type transistor (2N274) which embodies the significant "drift" principle, another new junction transistor of the germanium p-n-p alloy type (2N 404) has been announced by RCA's Semiconductor Division for use in high frequency operation and computer switching circuits.

In addition to its major applications as a high-frequency RF amplifier, the 2N274 can be used as a mixer-oscillator and IF amplifier in entertainment-type receivers. Excellent operating features are said to be inherent in its design.

The 2N404, designed for use in switching circuits of compact, medium-speed military and industrial electronic computers, is expected to find wide application in other low-level, medium-speed. "on-off" control cir-

cuits. The device is said to allow an electronic computer design to have exceptional stability despite wide variations in temperature.

Pocket Tape Recorder

The world's first pocket tape recorder, weighing only 2¾ lbs. and measuring 8½ x 3⅞ x 1⅞ inches has been developed by the Mohawk Business Machines Corp., 944 Halsey St., Brooklyn, N. Y.

Known as the "Midgetape," the unit uses hearing aid type batteries, sub-miniature tubes and a printed circuit case. Employing a dual track magnetic tape the size of a cigarette box, the Midgetape is said to permit recording up to 60 minutes.

Servo Systems Test Instrument

Solartron, Inc., of Camden, N. J., has announced a new electronic device which is capable of making an exhaustive test in a matter of minutes of servo systems, such as those used in guided missiles.

Regardless of harmonics or near-frequencies involved, the instrument only picks out the fundamental frequency wanted, discarding all unwanted signals and noise.

Called the "transfer function analyzer," the device is claimed to be the most advanced instrument known to test servo-mechanisms under conditions where output may be non-linear. Some 300 are said to be in use in Great Britain by missile contractors.

Image Orthicon Life Extender

Said to be the first such unit providing maximum prevention of burn-in and stickiness of images with no compromise in picture quality, the image orthicon life extender now being manufactured by the General Electric Company's Technical Products Dept. of Syracuse, N. Y., is expected to double the life of costly TV camera image orthicon tubes.

Designated the G-E "I/O-Guard," the unit measures 8½ x 5½ x 2½ inches, weighs 5 pounds and mounts easily on the exterior of 7 out of 8 TV cameras now in use.

Approximately 50 small parts are incorporated into the complete unit, including six capicitors, synchronous resolver and drive motor.

Thin Screen Amplifier for X-ray

Radio Corporation of America has revealed its new thin-screen amplifier for X-ray viewing, said to be capable of holding a bright image for viewing up to 30 seconds after a brief exposure to X-rays.

It is claimed that the device provides a stationary X-ray display up to 100 times brighter than conventional screens, retains its bright image after a short exposure and can be electronically "erased" for viewing a new image.

The significant reduction in the quantity of X-ray radiation that a patient need be exposed to during an examination is a major advantage of the screen.

Fully Automatic Industrial Control

In addition to computational capability, flexibility, precision and speed, the added functions of interpretation and manipulation are combined in the new fully transistorized, digital control computer, recently developed by the Ramo-Wooldridge Corp., Los Angeles 45, Calif.

Specifically designed to automatically control a wide variety of manufacturing processes, the "RW-300" operates as a central automatic control of an entire process system, or will perform any number of functions in automatic on-line process control.

Measuring 55 x 29 x 36 inches, the computer weighs about 400 lbs. Reliability is claimed through use of a minimum number of high grade components together with circuits having maximum tolerance to component and voltage variation.

Economic analyses of the control system in existing plants is said to have shown a return of the investment within one to three years.

Silicon Iron

Known as silicon iron, a new type of magnetic sheet material recently designed by General Electric Research Lab., Schenectady, N. Y., promises to increase efficiency of transformers, motors and generators.

"Orientation" in silicon iron is achieved by aligning individual crystalline grains in finished sheet material. Easily magnetized in 4 directions, the material can be made in a wide range of thicknesses. It is claimed that the "doubly-oriented," "four-square" effect is achieved by a different kind of alignment which gives excellent magnetic properties, both along and across the sheet.

New Literature

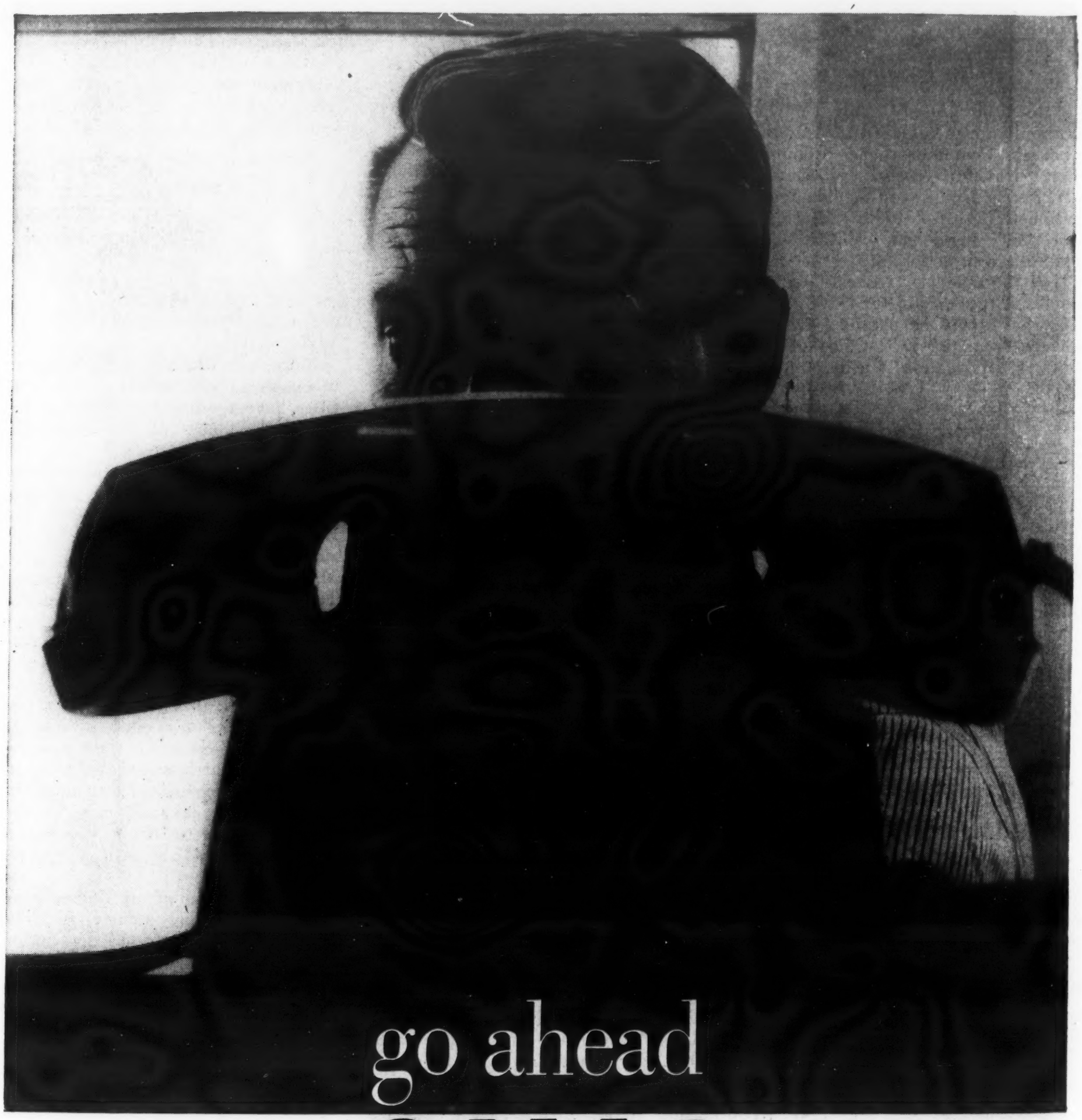
Qualified Product List

Cited as an excellent vehicle for aiding small firms to win Government contracts, the Qualified Products List (QPL), a directory of pretested items on which procurement is restricted to those manufacturers who have proven the quality of their products by laboratory tests, has been published by the Air Materiel Command, Headquarters, Wright Patterson Air Force Base, Dayton, Ohio.

Items are added to the QPL to assure the Air Force that they meet AF specifications and to eliminate wasted time, after contracting a manufacturer, for determining if the product qualifies for inclusion on the QPL. List inclusions are not limited to the electronics field.

In applying for product certification, the applicant states in writing that his product conforms to specifications as determined by his own testing, by a commercial testing laboratory or by arrangement with the Government wherein tests were performed in his behalf and at his expense.

(*Continued on page* 78)



CALL!

the fastest cure for worry about cancer: a call to your doctor now!

Scared? You shouldn't be! Look at it this way. The average man who walks into the doctor's office walks out floating. That lump that was so frightening . . . nothing to worry about at all! The sky's bluer, the air's sweeter, it's a great big beautiful day . . . because he picked up that phone and called!

It happens all the time. It can happen to *you*. "Sure," you say, "but just supposing". . . OK. Let's look at the facts. In past years, we were saving 1 out of 4 cancer patients. Today, we're saving 1 in 3. And the odds could get better still . . . if *people would call their doctors in time!*

So go ahead . . . call. See your doctor now. And after your checkup—how about a check for the American Cancer Society? Every dollar sends us further along the road to cure. And when *that* happens . . . it's going to be a wonderful day for us all! Send your check to "Cancer" in care of your local Post Office.

(*Continued from page 76*)

FCC Bulletin on Closed-Circuit TV

"Boom in Closed-Circuit TV Operation," a new bulletin issued by the Federal Communications Commission, provides general information concerning facilities in medical, educational, business, industrial, transportation, municipal, political and entertainment activities.

On individual request, single copies of the bulletin (#49583, Sept. 10, 1957) may be obtained free of charge from the FCC Office of Reports & Information, Washington 25, D. C.

Atomic Radiation

A new 120-page book treating the timely subject of atomic radiation and its effects is now available at the price of $1.60 from the Government Service Dept., RCA Service Co., Inc., Camden 8, N. J.

Using ample illustrations and simplified terminology, the manual discusses nuclear physics, observed biological effects of radiation, shielding methods, monitoring instruments, permissible radiation doses and medical evaluation of injuries and treatments. In addition to an excellent index, a supplementary list of reference literature is provided.

Primarily designed for use by technicians and scientists engaged in nuclear power activities, the book is believed to be of equal value to teachers, students, medical and civil defense workers, and the general public.

Navy Report for Better Electronic Design

Prepared for Navy electronic engineers, a 57-page report, entitled PB 121123 "Twelve Guides To Reliable Electronic Design," has been compiled by U.S. Naval Ordnance Laboratory for the design of reliable electronic equipment, and is now available at the price of $.50 from the Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D. C.

Principally compiled for aid in the design of ground-based data-gathering and data-assessing equipment, the report also covers other types of electronic devices. Drawn from an extensive literature survey, the volume includes an 89-item bibliography.

Among the studies forming a base for the guides are the effects of increased equipment complexity, distribution of causes of equipment failure, technique of reliable design and selection of components.

Weapon Systems Management

Reviewing achievements in the complete defense cycle, from research and development, engineering and design, to production, testing, installation and field maintenance, a new 32-page brochure, called "Weapon Systems Management—Through Computation," is now available from the Sales Promotion Dept., Defense Sales Div., Burroughs Corp., 6071 Second Ave., Detroit 32, Michigan.

Treatment of basic facilities and personnel at Burroughs is presented by way of introducing actual contracts in the various areas of interest.

Magnetic Tape Instrumentation

So as to acquaint readers with "instrumentation recording"—the use of magnetic tape for recording scientific research and industrial process data —Ampex Corporation of 934 Charter St., Redwood City, Calif., is offering at no charge a new booklet entitled "Magnetic Tape Instrumentation."

In view of the growth of instrumentation uses of magnetic tape recording to the degree that they now make up ⅔ of the business at Ampex, the booklet is believed to be of value for its detailed description of the functional capabilities and useful applications of the tape recorder. Included are the means by which tape can be applied in various analytical and control situations.

New Background for Marketing

Hoping to develop an organized body of basic theories and principles to explain consumer purchasing behavior and marketing on the American scene, *Life* magazine has been making a large survey of consumers' buying habits.

More than 30 distinguished leaders in business, Government and universities have recently appraised its potential usefulness at a round table discussion.

Designed to acquaint those interested in both the survey and the round table, a new booklet, "A New Background For Marketing Decision," is now available, gratis, from Mr. Andrew Heiskell, *Life* magazine, Time and Life Building, Rockefeller Center, New York City.

Layman's Guide to Computing Systems

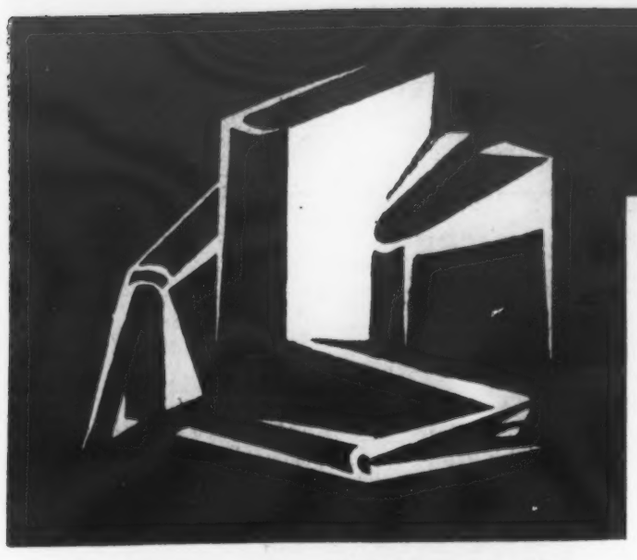
Entitled "How The Computing System Works For You," a 36-page guide to the electronic data processing system which is designed to clarify the mysteries of the electronic computer for the layman, may be obtained at no cost from Remington Rand Univac, 315 Fourth Ave., New York 10, N. Y.

A literary tour of the Univac Electronic Computing Center in New York, and an illustrated description of how an elementary computer can be made for less than $1, using only mechanical switches, a flashlight battery, bulb and wire, are among many meaningful and interesting sections found in this first of an educational series of booklets from Remington Rand.

Radiation Applied In Industry

Reporting on the significant new role of radiation, a 10-page paper entitled "Applications of Radiation in Industry," by Ashton J. O'Donnell and Bruce Graham, was presented at the Conference on Peaceful Uses of Atomic Energy, in Tokyo, on May 13, 1957. Free reprint copies may now be obtained from the Stanford Research Institute of Menlo Park, Cal.

Hailed as a tool with a promising future, radiation is described as capable of efficient performance of operations from actuating an electronic signal to inducing a chemical reaction.



Books

AUTOMATION: ITS PURPOSE & FUTURE, by Magnus Pyke. Philosophical Library, New York. 191 pages, $10.00.

The idea of automation has a particularly sparkling glitter about it as we now begin to grasp the remarkable technological possibilities that lie before us. In addition, the steadily increasing cost of labor should have its impact upon business management as a great motive force in the acceptance of automatic equipment.

However, Dr. Pyke points out the three causes holding back such acceptance, and places the responsibility for low productivity: "If technological advance and industrial efficiency are low, I would first blame those people who manage businesses rather than the workmen who man them."

The author's treatment of factors affecting the speed with which automation will spread in different countries is believed to be an important contribution to this work. "Most important is the 'climate of opinion;' this is partly a growth of the national philosophy."

ROCKETS, MISSILES, AND SPACE TRAVEL, by Willy Ley. Viking Press, Inc., New York. 528 pages, $6.75.

Ley's timely and newly revised edition is designed to capture the interest of the reader, whether his curiosity concerns historical background, the present progress to culminate in Project Vanguard, or such future concepts as atomic-powered rocket propulsion, space stations, the circling of the moon and planetary probes.

Including a description of the remarkable performance with which the Jupiter C broke all distance and altiture records, the work covers all modern data resulting from the past 6 years of progress in both theoretical and practical fields.

Of importance in the discussion of future projects are the papers given at the Franklin Institute Symposium on "Earth Satel' .es as Research Vehicles," in 1956.

Completing the work are two appendixes, a 31-page bibliography and a comprehensive index.

CLOSED CIRCUIT TELEVISION SYSTEM PLANNING, by M. A. Mayers and R. D. Chipp. John F. Rider Publisher, Inc., New York. 250 pages, $10.00.

Closed circuit TV, the infant prodigy born shortly after the end of WW II, is today a burgeoning youngster with numerous profitable applications in industry, education, commerce, business and medical institutions. Beyond the actual engineering of equipment for closed circuit TV systems, there is required careful evaluation and planning before an intelligent decision can be made as to where and how a particular organization can best use closed circuit TV. For those who undertake such a responsibility, this book is believed to offer an authoritative and complete advisory source.

Space requirements, cost of equipment and its installation, types of equipment available, their utility and functioning, and the manpower needed to operate and maintain such equipment—all are fully described and illustrated together with clear statement of both capabilities and limitations.

KHRUSHCHEV OF THE UKRAINE: A BIOGRAPHY, by Victor Alexandrov. Philosophical Library, Inc., New York. 216 pages, $4.75.

The shepherd-blacksmith who has dedicated his life to one aim for Russia—prosperity via socialism—the first Soviet leader to establish the precedent of being seen walking among his people, the outgoing wily Ukrainian who is a master of political self-defense, the outright dictator who handles hints of students' anti-governmental movements with threats of expulsion to Siberia, Nikita Khrushchev, top echelon of a great atomic power, has been quoted by Pravda to have said: "I shall never hesitate to use violence to save Lenin's work!"

Of special note in Mr. Alexandrov's timely book are the unpublished revelations concerning Khrushchev's famed secret 3-hour speech in which Stalin, his works and his living associates were denounced. Also of interest is the detailed portrait of post-Stalin Russia in which there gradually rose a determined, extraordinary man to the top Kremlin post.

CAREER SATISFACTIONS OF PROFESSIONAL ENGINEERS IN INDUSTRY, a Survey conducted by the Opinion Research Corp., Princeton, N. J. The Professional Engineers' Conference Board for Industry, 2029 K St., N. W., Washington 6, D. C. 84 Pages, $3.00.

Based upon intensive personal interviews with a sampling of professional engineers, this survey report represents the outlook of those men associated with 11 of the nation's largest industrial corporations in the fields of aircraft, automobile, manufacturing, chemicals, electronics, electrical machinery, heavy equipment, petroleum refining and rubber.

Contrasting the ideas and opinions of those whose careers are in the early stage of 3 to 5 years, in the middle stage of 10 to 15 years, and in the later stage of 20 to 25 years, the examination reveals the differences in values and thinking among the more successful engineers.

Among the sundry subjects treated are such topics as desired management which endorses means for fostering professional recognition, varied views regarding professional status in the company hierarchy, deficiencies in college backgrounds, opportunities for further training and advancement, and attitudes toward professional engineering societies.

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The primary objective of the Armed Forces Communications and Electronics Association is to maintain and improve the cooperation between the Armed Forces and industry in the design, production, maintenance and operation of communications, electronics and photographic equipment in times of peace as well as war.

SIGNAL, the official magazine of the Association, is a continuing contact with the professions of electronics and communications. Through its editorial pages and its advertising, SIGNAL provides a means of keeping in close touch with national and international trends and major developments of professional interest.

It is a magazine worth reading. It is a publication worth keeping. For the small sum of 41 cents a month, you can obtain participating membership in a local chapter and receive 12 issues of SIGNAL each year.

The membership blank below is provided for your convenience.

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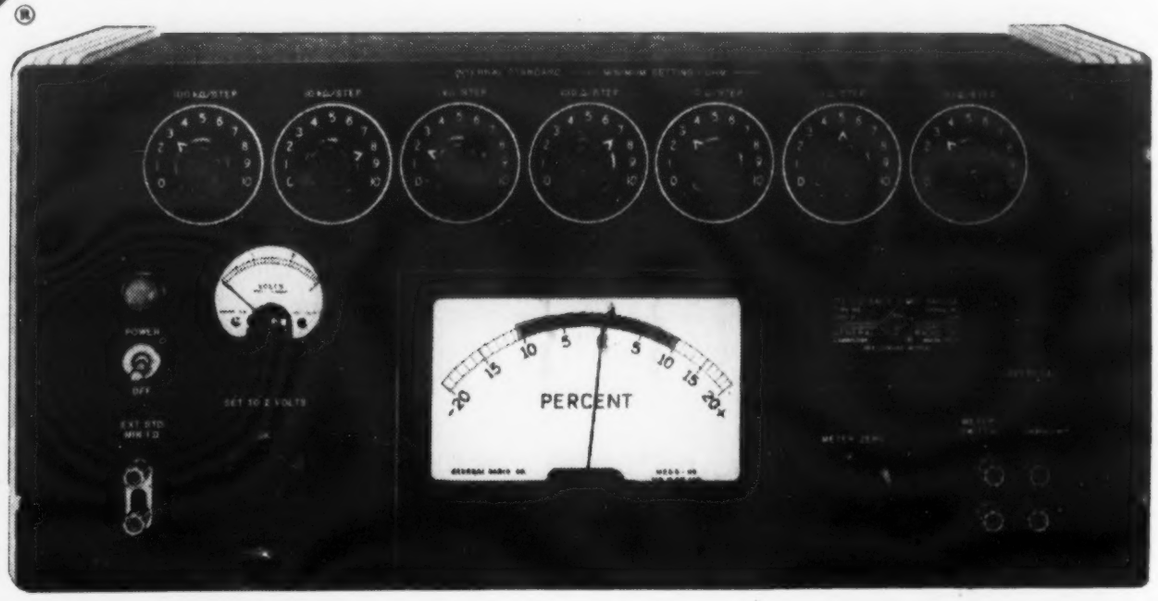
Rapid Production Testing

with the GR TYPE 1652-A RESISTANCE LIMIT BRIDGE



- No Balancing
- Direct Reading
- Built-in Resistance Standards
- Can be Adapted for Automatic Sorting

The G-R Limit Bridge can be easily used by anyone. Built-in resistance standards are set to the component's specified value. As each unknown is connected to the Bridge, a large easily-read meter indicates component resistance directly as a percentage of its specified value . . . no further adjustments are necessary and measuring procedure reduces to simply placing the unknown into the Bridge circuit and reading one meter. Computations are eliminated, the possibility of error is reduced, and valuable testing time is saved.

The Hart Manufacturing Company of Hartford, Connecticut, producer of "Diamond H" precision relays and switches, maintains a continuous check on relay coils with the General Radio Resistance Limit Bridge. Two Bridges are used in their production operations . . . one in the coil winding department for initial d-c resistance measurements, and one in the inspection department for final specification checks on the assembled relay.

Type 1652-A Resistance Limit Bridge $495

Resistance Range: Used as a limit bridge, 1 ohm to 1,111,111 ohms. Used as a Wheatstone bridge, 1 ohm to 1,111,111 ohms with internal standard; 1 ohm to 2 megohms with external standard.

Limit Range: Meter reads from −20% to +20%; ±5% and ±10% scales clearly indicated with color coding.

Accuracy: As a limit bridge, ±0.5% or better; for matching resistances, ±0.2%. As a Wheatstone bridge with internal standard, ±0.25% above 10 ohms, ±0.4% below 10 ohms. With external standard, ±0.2% + accuracy of standard (from 1 ohm to 2 megohms).

Mounting: The bridge is supplied for either relay rack or table mounting.

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Here's the Army's answer to a major problem in U. S. defense. Hawk, recently-revealed missile, hunts and destroys invading aircraft *even at tree-top altitudes!*

Raytheon radars of unique design give Hawk its amazing low-level ability in the blind zone of conventional radars.

This aptly named 16-foot missile is launched from fixed installations for the defense of U. S. cities. Highly mobile, Hawk can also travel with fast-moving land forces, or be carried by helicopter or plane.

Raytheon, with more than a decade of pioneering in guided missiles, is prime contractor for the complete Hawk weapon system.

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